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THE GEOGRAPHICAL JOURNAL

Vol LXXV No 4 April 1930

Major James Rennell . . . . . Rennell Rodd 289
Boundary Work in the Balkans . . . . . Colonel Frank L. Giles 300
The Climatic Conditions of the Tarim Basin
Lieut.-Colonel Reginald C. F. Schomberg 313
Further Notes on the Shore Topography of the English Lakes Thomas Hay 324
The Mountains about Tatsienlu 345
Sketches of the Tatsienlu Peaks . . . . . Herbert Stevens 353
Canadian Geographical Society 356
Biography of Captain Scott: Review . . . . . F. D. 357
Landforms of Central and Southern France: Review . . . A. G. O. 359
Reviews The Monthly Record Obituary Correspondence
Meetings: Session 1929–1930
Society Notices iii
Contents v

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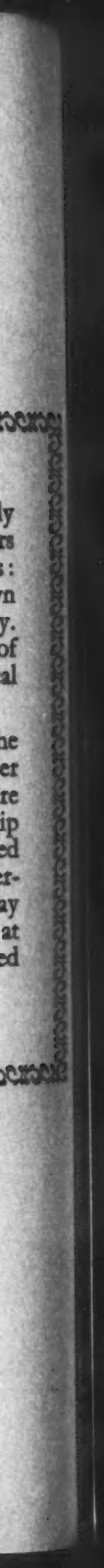

CONTENTS

MAJOR JAMES RENNELL. By RENNELL RODD 289

BOUNDARY WORK IN THE BALKANS. By COLONEL FRANK L. GILES, D.S.O., O.B.E., late R.E. 300

THE CLIMATIC CONDITIONS OF THE TARIM BASIN. By LIEUT.-COLONEL REGINALD C. F. SCHOMBERG, D.S.O. 313

FURTHER NOTES ON THE SHORE TOPOGRAPHY OF THE ENGLISH LAKES. By MR. THOMAS HAY 324

THE MOUNTAINS ABOUT TATSIENLU 345

SKETCHES OF THE TATSIENLU PEAKS. By MR. HERBERT STEVENS 353

CANADIAN GEOGRAPHICAL SOCIETY 356

BIOGRAPHY OF CAPTAIN SCOTT: Review by F. D. . . . 357

LANDFORMS OF CENTRAL AND SOUTHERN FRANCE: Review by A. G. O. 359

REVIEWS: The Physiographical Evolution of Britain. Albania. Sulle Orme di Marco Polo. Im Land der Stürme. Landmarks of the Deccan. The Muhammadan Emirates of Nigeria. Gazetteer of Ilorin Province. From Coast to Coast by Motor. Twenty-five Years in South America. Founders and Pioneers of South Australia. The Economics of Australian Coal. La Mer du Groenland. Scientific Results of the Norwegian Antarctic Expeditions, 1927–1928 and 1928–1929. Earth Flexures. La Nouvelle Cythère (Tahiti). Livingstone. The Pitcairn Island Register Book. Round the World on a Cycle. The Growth of the World and its Inhabitants. Great Navigators and Discoverers. Hakluyt's Voyages. A Geographical Grammar. Mast and Sail in Europe and Asia . 364

THE MONTHLY RECORD: Third General Index. Changes in the Course of the Trent. Forests of the Karst. Further Explorations by Dr. and Mrs. Visser. A Saharan Meteorological Record. Railway for South-West Tanganyika Territory 376

OBITUARY: Dr. Charles Hose, D.SC. 380

CORRESPONDENCE: The African Bulge. Zerzura . . . 381

MEETINGS: Session 1929–1930 384

MAPS:

Sketch-map to illustrate Colonel Giles' paper 302
The Boundaries of Albania 306
Sketch-map to illustrate Col. Schomberg's paper on the Tarim Basin 314
Sketch-maps of Glenridding, Church Beck and Yewdale Beck deltas. 342, 343
Sketch-map showing positions from which Mr. Stevens' sketches were made 354
The Shore Topography of the English Lakes . . . *following* 384
Sketches of the Tatsienlu Peaks . . . . . *following* 384

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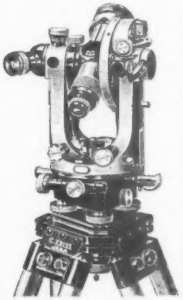

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Major James Rennell, F.R.S.

The
GEOGRAPHICAL JOURNAL

Vol LXXV No 4 R.G.S. *April 1930*

MAJOR JAMES RENNELL

Born 3 December 1742. Died 29 March 1830

ON the centenary of his death, which fell on 29 March 1930, the Royal Geographical Society did honour to the memory of Major James Rennell. Such a tribute was right and just for two reasons. Not only is he recognized to-day, as he was by his contemporaries both at home and abroad, to have been the first eminent British geographer; but it seems hardly open to doubt, though he did not live to see the Society actually constituted, that it was in consultation with him that his intimate friend Admiral Smyth began to enrol members for an institution which was being simultaneously promoted by Sir John Barrow, the secretary to the Admiralty. The society was in fact founded within two months of his death. It is appropriate therefore that a brief commemorative sketch should find a place in its *Journal*.

The career of Rennell may be divided into two periods, that of his earlier years of adventure as a sailor, an explorer or a surveyor, and that which covered more than fifty years at home of laborious and far-reaching study extending over every field of geographical activity.

Life did not open very auspiciously for the future geographer, who was born on 3 December 1742 at Upcot, one of two small Devonshire properties situated about a mile from Chudleigh, on the river Teign, which had been owned for several generations by his family. His name, which has been spelt in more ways than one, appears to be a variant of the better-known Reynell, borne by an ancient Devonshire family of French origin. His grandson learned from him that one of his earliest memories dated from his fifth year, when his father embarked as a captain of artillery for the war in the Low Countries. And there soon afterwards, in July 1747, Captain John Rennell was killed in action, leaving a widow with a son and a daughter in such straitened circumstances that they were obliged to part with the Devonshire estates, one of which however was eventually recovered after a lawsuit in 1769, while James Rennell was in India.

The widow with her children found a temporary home with a cousin, the rector of Drewsteignton, near Exeter, but on the transfer of this Dr. Rennell to a living in Northamptonshire she made a second marriage to a former

Chudleigh neighbour. Having a family of his own, Mr. Elliot the stepfather, whose means were small, was unable to provide for two additional children, and young Rennell was at the age of ten practically, if not formally, adopted by the new Vicar of Chudleigh, the Reverend Gilbert Burrington, with whom he found a very happy home. There is a family tradition that already in those early years he showed evidence of his future tastes by making a map of the country surrounding the village and the venerable church in which the effigies of Sir Piers Courtenay and his wife may still be seen kneeling side by side. The only schooling he enjoyed seems to have been at the local grammar school.

But young Rennell was one of those who absorb all the books which come in their way and educate themselves. Like so many other lads of Devon in the days of Hawke and Anson, he felt the call of the sea. Through the influence of a mutual friend his guardian was able to secure for him an appointment as midshipman in the frigate *Brilliant*, which Captain Hyde Parker was then engaged in commissioning. And so at the age of fourteen he left his kind friends at the vicarage for good, as it was to prove, and took the Exeter coach which ran through Chudleigh to Plymouth. A month or two later a boy's dream of adventure seemed to be fulfilled when the war with France broke out which was to last for seven years. Life was rough and fare monotonous in those days on the orlop deck for the midshipman who, as Rennell's contemporary Falconer described him, had to wield "the sword, the saucepan and the book," and was not "passing rich on 30 pounds a year." But he was fortunate in his messmates, and particularly in his commanding officer. Hyde Parker had served under Anson in the famous voyage of circumnavigation, and his interest in all marine problems no doubt led him to encourage his midshipman's natural disposition for surveying.

The first chart made by Rennell which has been preserved was a careful study, dedicated to Lord Howe, of the Bay of St. Cast, where he witnessed the disastrous re-embarcation of the troops originally landed for an attack on St. Malo, which had to be abandoned. A rearguard of Grenadiers, 1200 strong, under Colonel Davy, was practically annihilated under his eyes, while the frigate drew too much water to get within effective range of the enemy. In the following year the *Brilliant*, under a new commander, had the fortune to capture two French privateers. A modest but very welcome share of prize money fell to the midshipman, who after a long spell of service at sea was granted leave. It was characteristic of him that he spent a portion of this money on books.

His first protector, Captain Hyde Parker, now in command of the *Norfolk*, a 74-gun warship proceeding to the East Indies, had consented to give him a berth. But the transport on which he had secured a passage to Portsmouth, where she was fitting out, ran on a shoal, and though she got off again the delay had been fatal and he found the *Norfolk* had sailed. After some weeks of the uncertainty incidental to the seaman's life in the days of sail, he secured a place as a midshipman in the frigate *America*, and started for Madras on 6 March 1760. Eighteen years were to pass before he saw his native land again. The voyage out, during which Rennell made plans of harbours and anchorages, occupied six months, which included a fortnight's stay in Madagascar to give

the crew the necessary antidote to scurvy—fresh food and fruit. The ship would have been a happy one but for the violent temper of the captain, whose use of his fists and his stick aroused the bitter resentment of the midshipmen.

On their arrival at Madras the influence of Hyde Parker secured Rennell's transfer to the *Grafton*, of which he had taken over the command when the *Norfolk* became the flagship. The British fleet, consisting of sixteen ships of the line with six frigates under Admiral Stevens, proceeded to Pondicherry, to co-operate in a blockade which Colonel Coote had organized on land. Rennell was selected to take part in an expedition to cut out the French frigate *Baleine* and an Indiaman, which were lying under the guns of the fort. The frigate, which was boarded at two in the morning, was for at least an hour under their fire before she could be got to sea. But the operation was completely successful and the losses relatively small. During the rainy season the majority of the ships went to Ceylon, and there Rennell made a survey of the harbour of Trincomali. It was no doubt also at this time that he first investigated the chain of sandbanks, known as Adam's Bridge, separating Ceylon from the south-eastern extremity of the Coromandel coast, across which he declared that a navigable passage could be maintained by dredging the strait of Ramisseram. It was pointed out in a biographical sketch of Rennell issued in 1842 by Baron de Walkenaer, the secretary of the French Academy, that, though no notice was taken at the time of the suggestions put forward by so young and unknown an officer, the idea was revived some sixty years later. Almost immediately after their return a hurricane burst with disastrous effect upon the fleet while lying at anchor. An Indiaman and two ships of the line were lost, five more were dismasted, and three fire ships were driven ashore. The only vessels which saved their masts were the *Grafton* and the *Norfolk*, both of which Hyde Parker had commanded. The blockade of Pondicherry was none the less maintained until it capitulated on 17 March 1761.

A project for the capture of Bourbon and Mauritius, conceived by Admiral Cornish, who after the death of Stevens succeeded to his command, next took the East Indies squadron to Rodriguez, an island 344 miles east of Mauritius, originally discovered by the Portuguese, which the Governor of Bourbon had annexed. There Cornish had been instructed to await a fleet under Keppel, who was to take over the direction of the expedition. Rennell employed his time in making a survey of the harbour, Port Mathurin, and studied the natural history of this curious volcanic island surrounded by a reef of coral. It was then well wooded and haunted by giant land tortoises. The coastal waters were alive with fish and turtle, of which, Rennell wrote in one of his letters, the fleet was calculated during its stay to have consumed sixty thousand. But seamen cannot live on turtle alone, and after a stay of seven weeks the exhaustion of his supplies compelled Cornish to return to Madras, where he learned to his chagrin not only that Keppel had not started, but that no preparations had ever been made for the expedition. The plan which he could perfectly well have carried out with the resources at his disposal was thus rendered abortive by the ineptitude of the authorities at home.

Commissions and promotion in the navy were in those days only procured by favour, and young Rennell was wholly without interest, though he never

lacked friends. There was evidently some endearing quality in the young sailor which made him popular with his messmates, that quality no doubt which his letters reveal of always making the best of things. Six years of meritorious service at sea had gained for him the esteem of his captain, who suggested to him the advantages of entering the East India Company's navy. He was accordingly lent experimentally as surveying officer to one of the Company's warships which was to endeavour to establish trading relations at various places on a cruise, the ultimate destination of which was the Philippines. When he returned to Madras about a year later with charts from the Nicobar islands, Malacca, and North West Borneo, he was at once offered the command of a ship which, in consequence of the absence of his captain, he was then unable to accept. With the termination, however, in 1763 of the Seven Years' War, which made any prospect of a naval career precarious, he decided to enter the Company's service and was discharged from the Royal Navy.

The first ship of which he was given the command was destroyed by a hurricane in Madras roads. Being on shore at the moment when the vessel was struck, Rennell was fortunate in escaping with his life, but all his modest possessions were lost. It was however not long before he was appointed to a small coasting vessel, apparently chartered by the Company. The Governor of Madras, Mr. (afterwards Sir Robert) Palk, was also a Devonshire man whose home at Haldon was close to Chudleigh. This may account for the interest he took in the son of a former neighbour. Through the governor's influence Rennell was given a commission to superintend the transport and landing of troops and stores destined for the siege of Madura in the south of the Presidency. The work of the small squadron commanded by this very young commodore earned for him the thanks of the Madras Government and a donation, which was the more merited because in the intervals of service he had carried out a number of valuable surveys. Then the miracle happened. At Calcutta he fell in with a squadron under a Captain Tinker who had shown him particular kindness during his naval service, and he renewed acquaintance with a former messmate who had been his closest ally in the *Brilliant*. This Mr. Topham, who had joined the Company's civil staff, was in intimate relations with the Governor of Bengal, Vansittart, the brother-in-law of the Governor of Madras. Vansittart was anxious to have his province carefully surveyed, and through the recommendation of these friends Rennell found himself at the age of twenty-one appointed to carry out this important work. To facilitate his duties he was given a commission in the Bengal engineers, first as an ensign, from which rank he rose quickly to be a lieutenant. In 1766 he became a captain, and finally on his retirement a major. Thus it happened that the geographer who was essentially a sailor came to be distinguished thereafter by the modest military title of which Baron Walkenaer wrote many years later: "ce simple titre de major, que l'on s'est habitué à ne point séparer du nom du géographe anglais pour le distinguer de ses homonymes, semble, lorsqu'il est question de lui, acquérir un lustre supérieur aux autres titres."

His first attention was paid to the course of the Ganges. A manuscript recording meteorological and geographical observations made on the river, which was found among his papers and sent out to India some hundred and forty years later by his great grandson, was found by the Survey Department there to be

extremely valuable for comparative purposes. The initial work accomplished was highly esteemed by Mr. Vansittart, whose recommendations to the Company secured for Rennell an income of £1000 a year, out of which he at once made adequate provision for his mother and sister, while he testified his gratitude to Mr. Burrington by handsome presents to his guardian's sons.

Before two years were over his survey had brought him within sight of a vast mountain range to which he gave the name of the Tartarian Mountains. To-day we call that system Himalaya. His headquarters were established at Dacca, where he built himself a house. It was there that he learned to know Mr. (afterwards Sir Hugh) Inglis, a wealthy India merchant, who in 1812 became chairman of the Company, and remained until his death in 1820 one of Rennell's most intimate friends. Ensign Richards of the Engineers was appointed to be his assistant by Lord Clive, who gave every encouragement to the pioneer work of the young surveyor in a difficult, unhealthy, and at that time almost unexplored country.

In 1766, on the frontier of Bhutan, Rennell came very near to losing his life, through volunteering to join an old naval acquaintance, Lieutenant Morrison, then serving in a Sepoy regiment, on a dangerous expedition against a fanatical tribe known as the Sanashi Fakirs, who had looted a town just off the line of march. While reconnoitring a village where they had not expected to meet with any of the enemy, the officers found themselves surrounded by the Fakirs. Morrison, Richards, and the Sepoy adjutant cut their way out, the two last with wounds. Rennell's Armenian assistant was killed, and he himself, his pistol having missed fire, retreated, defending himself with a short sword against the sabres of his assailants. He was so severely wounded that his case seemed desperate, and he was therefore only pursued by a single tribesman, whom he managed to put out of action. His remaining strength he used to run, under a constant fire, towards the detachment coming to the rescue. Before they could reach him he had fainted from loss of blood. His shoulder-blade and some ribs had been cut through by a sabre. He had a number of lesser wounds and very severe cuts in the arms and the left hand, the forefinger of which he was never after able to use. There was no surgeon with the expedition. He was carried, as all believed in a moribund condition, with pounded onions on his wounds, and laid in an open boat which took six days to reach Dacca, where his friend Dr. Francis Russell, the surgeon of the station, despaired of saving him.

But the strong vitality which in seafaring days had kept him immune from scurvy when the majority of a ship's company were affected, carried him through. Slowly his wounds healed and the movement of his arms was restored. But his health was permanently affected by the loss of blood, and his right arm never entirely recovered its freedom of action. Lord Clive, who created for Rennell the definite rank of Surveyor-General, gave orders that thereafter he should always be escorted by a company of Sepoys. Rennell owed much to Clive, who did justice to good work, but as a man dependent on his salary he greatly resented a measure which the Governor, who had been instructed to enforce economies, now took to reduce military allowances. He was himself curtailed of six rupees a day. In a letter written at that time, when the officers of the first and third brigades threw up their commissions, so far from condemning their insubordinate action Rennell compared the spirit of a State composed of

merchants to that of the Carthaginians who disbanded their mercenary troops after they had saved them from ruin.

The actual field-work of the survey occupied some seven years, and in the country east of the Brahmaputra, where both man and beast were savage, might almost be said to have been carried out at the point of the bayonet. An attempt to ambush the expedition was defeated. A leopard mauled five of his men before Rennell succeeded in killing him with a bayonet driven down its throat. In 1771, as a diversion from his normal duties he was instructed to lead an expedition against a band of border raiders. It entailed a rapid march over 320 miles, accomplished in fifteen days, probably a record in such a climate. Malarial fever also frequently interrupted his work. In after years he used to recall these stories of his Indian adventures to his grandson, who repeated them to the present writer.

In 1768 Mr. Cartier, the former Resident in Dacca with whom Rennell had become very intimate, succeeded to the Governorship. It was in his house at Calcutta that the Surveyor-General met his future wife, Jane Thackeray, sister of the Governor's secretary. She was one of fifteen children of Thomas Thackeray, headmaster of Harrow and archdeacon of Surrey, whose family played a distinguished part in the early administration of India. The youngest son, William Makepeace, grandfather of the author who was himself born in Calcutta, entered the Bengal service in 1765, and two of his eight sisters had gone out to keep house for him. After a year's engagement the marriage took place at the Governor's house in October 1772, the year in which Warren Hastings relieved Mr. Cartier. The union was a very happy one, and Mrs. Rennell had the pleasure of seeing her sister, who was seventeen years younger, married to Mr. Harris, the Resident, during a visit which she paid to Dacca.

The period following his marriage was chiefly devoted to co-ordinating materials accumulated during many years of collection and in the preparation of the fourteen sheets of the Bengal Atlas. When this work was practically completed by the beginning of 1777 Rennell, whose health had been seriously undermined by wounds and fever during his long and uninterrupted residence in India, applied to the Governor for a pension, which Warren Hastings, in view of his exceptional services, recommended the Directors to fix at £600 a year. He left Calcutta with his wife in March 1777 in the *Ashburnham*, which made St. Helena without incident. The first child of their marriage, a daughter born at Dacca, had only survived a year, and, as another confinement was expected and the duration of sea voyages was in those days incalculable, they decided to await the event there. And so it happened that a daughter, who was to become the active collaborator of her father in after years, was born in St. Helena on 12 October 1777 and was given her mother's name. Only a storm which kept the decks awash for several days broke the monotony of a two months' voyage to Portsmouth, where the *Hector* at length arrived in February 1778. Rennell's mother had died two years earlier, but the family were made very welcome by Mrs. Thackeray at Harrow. The analogy which some twelve years earlier Rennell had suggested between the conduct of the Carthaginians and the attitude of a Merchant State towards its officers must have recurred to his mind when he found on returning home that the Directors had cut down the

figure proposed for his pension from £600 a year to £400. Nor were they disposed to defray the cost of publishing the Bengal Atlas, the fruit of so many years of labour, which was produced by subscription from the Company's servants in India. Two years later however they repented of their former decision, and in 1781 decided to grant the full pension which Warren Hastings had recommended.

After visits to his relatives by marriage and to his old home at Chudleigh, where his former guardian and constant friend Mr. Burrington was still in charge of the rectory, the Rennells settled in London, first in Charles Street, Cavendish Square, where two boys were born, and subsequently, in 1781, at 23 Suffolk Street, which has since been renamed Nassau Street. There began the second period of his life's activity, with the preparation of his Map and Memoir of Hindoostan, which first gained him fame with a wider public. Lack of opportunity in his early years had deprived him of a classical education, but his assiduous reading had taught him that the Greeks had been the first students and exponents of the science to which he had devoted his life. As a basis from which to set out he accordingly resolved to investigate with his habitual thoroughness the legacy of the ancient world as bequeathed not only by such exceptional travellers and observers as Herodotus, Xenophon, and Thucydides, or geographers like Ptolemy and Strabo, but by all the authors of the ancient world whose writings could throw light on the subject. Unfortunately their works were only accessible to him through English and French translations, many of which in those days were, like Beloe's Herodotus which he used, of inferior quality.

Of the geographical literature of the Middle Ages and the Renaissance, so far as it was in those days accessible, Rennell made himself a master. A very retentive memory assisted his comparative analysis, and reflections and analogies introduced into the text of his geography of Herodotus show how wide had been the range of his studies. As his reputation became established, moreover, he had the advantage of receiving informative communications from British travellers and from such eminent authorities abroad as Niebuhr and Von Hammer. He entertained the greatest respect for his French predecessors in geographical research, Delisle and especially D'Anville, who was born some forty-five years earlier, and, though he sometimes differed from the conclusions of one whom he looked up to as master, his criticisms were always advanced with deference and respect.

The qualities of simplicity and sincerity which had won him many friends in his seafaring days and in the Company's service quickly drew round him in London, where his wife's family had a numerous connection, a group of remarkable men. In 1781 he was elected a Fellow of the Royal Society, a privilege to which the publication of the Bengal Atlas entitled him. Its president, Sir Joseph Banks, the naturalist and traveller, who had been with Captain Cook on his first voyage round the world and who contributed from his considerable fortune to the advancement of science, became his close intimate. The great Whig peer, Lord Spencer, to whom he dedicated his Herodotus, took him into very cordial friendship. Dr. Gillies the Scotch historian, Marsden the translator of Marco Polo, and Inglis his former acquaintance at Dacca and afterwards chairman of the Company, were members of the

group with whom he was constantly associated. These and many more meeting in each other's houses formed one of those pleasant coteries of the learned which were possible in the less distracted London of the late eighteenth and early nineteenth centuries. Like most of the men with whom he was in touch, Rennell was a Liberal or rather a Whig in politics, but while holding strong opinions he was careful to restrict his activities to a purely scientific field.

The contribution to geographical knowledge on which Rennell's fame is established included three distinct branches of research. He had, in the first place, contemplated a comprehensive study of the geography of Western Asia, from the Mediterranean to India, beginning from the earliest records, and for this purpose had amassed a vast number of notes. A treatise and a map indicating the scope of the work which he had in view were published after his death by his daughter. To this ambitious project belong his 'Geographical System of Herodotus,' the 'Expedition of Cyrus,' and the 'Topography of the Plain of Troy.' The 'Geography of Herodotus,' whose accuracy of observation and correctness in marking relative positions he strove to vindicate, acquired for him an European celebrity. The second volume is entirely devoted to Africa. He brought his knowledge of currents and trade winds to bear on the legend of the circumnavigation of Africa by Phoenician sailors, and after a careful examination of the conditions prevailing in those days, concluded that such a voyage might have been accomplished in two and a half years. Applying similar criteria he also devoted a section of the book to the Periplus of Hanno.

The foundation in 1788 of the African Association, of which Rennell was at once made an honorary member, led him to concentrate his activities for a considerable time on the study of African geography. He worked on the routes and classified the observations of the travellers who had personally investigated the northern half of that continent, or had been despatched for that purpose by the Association, William Browne, Major Houghton, the German explorer Friederich Horneman, and the most remarkable of the four, Mungo Park. Rennell, who died before the problem of the Niger had finally been solved, published a series of Memoirs with Maps prepared for the African Association.

The third field of research, of which he may be regarded as the originator, was connected with the science of oceanography, a name which does not seem to have been established in the language until the systematic co-ordination of his studies of winds and currents created the need for such a designation. He had, as has been shown, begun from his earliest years to prepare charts to assist navigation, but his first serious effort as a hydrographer was his Chart of the Bank and Current of Cape Lagullas, which was published in 1778. As a sailor he had studied by personal observation the currents of the Atlantic, the Trade-winds, the Monsoons, and their influence on the drift in the Ocean, and he assembled over a number of years all the information he could gather from the experience and the log-books of his naval friends. His seven charts of the winds and currents with a memoir, based on an immense store of material which he had reduced to system by 1810 and continually revised in subsequent years, were only published by his daughter after his death. The last of the seven is devoted to the current with which his name is associated. He had already, in 1793, read before the Royal Society a paper embodying his "Observations of a current which often prevails to the westward of Scilly, endangering the safety

of ships that approach the English Channel." Up to that time navigators had not realized that the current which turns eastward round Capes Ortegal and Finisterre and sweeps along the French shore of the Bay of Biscay, continued to flow, with varying force according to the state of the winds, across the mouths of the English and the Irish channels. And yet the deviation from their course of vessels when the drift was exceptionally strong had been responsible for many disasters and, as now became clear, accounted for the loss of Sir Cloudesley Shovel's flagship and two others of the line in 1707. Further evidence regarding the action of this current was submitted in a second paper read to the Society in 1815. The great service rendered to navigation by this identification makes it right that his memory should be preserved in the name of Rennell's Current.

This indefatigable worker also found time to write papers on historical or archaeological subjects associated with geography, such as the Marches of the British Army in the Peninsula of India, the Ruins of Babylon, the Identity of the Site of Jerash, the Landing of Julius Caesar in Britain, and the Shipwreck of St. Paul. His correspondence with Lord Spencer covers a wide range of interests, including details connected with the naval service, and his letters to friends and fellow-workers are full of valuable suggestions and evidence of close observation. But it is not possible in a brief memoir to do justice to the contents of the many publications in which his researches are recorded. Those who may be interested to pursue the subject will find them summarized in the excellent biography of Rennell prepared by the late Sir Clements Markham for the Century Science Series. A valuable appreciation of the great geographer was also contributed by Sir Henry Yule to the *Royal Engineers Magazine*.

Rennell's unquestioned authority as a student of oceanography led to an offer of the post of First Hydrographer to the Admiralty, which however he did not see his way to accept, as it would have interfered with his work of research and co-ordination. This seems to have been the only official recognition ever entertained of his eminent services to science and navigation. But he received universal recognition from the learned in every European country. In a contemporary record of the 'Public Characters of 1803–4' it is maintained that scarcely any work having reference to geography had been published in preceding years which had not been submitted to his correction, and that none were ever returned without attention. The courtesy and generosity with which he assisted the labour of others were indeed characteristic of this kindly sage, and in his obituary notice in *The Times*, where it is repeated that few ever applied to him in vain, the following passage occurs: "Adapting himself to the level of all who consulted him, he had the happy art of correcting their errors without hurting their feelings, and of leading them to truth without convicting them of ignorance."

As early as 1791 Rennell had been awarded the Copley Medal of the Royal Society. In his presidential address Sir Joseph Banks referred to the Bengal Atlas as having been "executed with a degree of exactness that has not been paralleled by the most applauded geographers of this or any preceding age," and in discussing the Memoir of the Map of Hindoostan he went on to say: "The perspicuous and masterly style in which it is composed clearly indicates that, though geography is the field on which he has principally relied for the

cultivation of his laurels, he is able to reap no inconsiderable crop when he chooses to labour in the more capricious harvest of *belles lettres*."

Rennell had indeed acquired a clear and masterly command of English. His feeling for the value of language is reflected in a passage in his 'Geography of Herodotus,' where he writes: "It ought perhaps to afford a triumph to literary men to reflect that the English language had received its highest degree of improvement before the epoch of our great colonization." He therefore frankly admitted his gratification when the gold medal of the Royal Society of Literature was conferred upon him in 1825. He had been made a foreign Associate of the French *Institut National* in 1801, in token of which he received a silver medal inscribed with his name. The Academy of St. Petersburg and the Gothenburg Society had also enrolled him among their members. As a testimony of the esteem in which his work was held on the Continent Rennell very greatly appreciated the visit paid him in 1825 by the illustrious Baron Humboldt, who came to London to consult him on the problem of winds and currents. No more graceful tribute has been paid to his memory than that contained in a historical note on his life's work read to the French Academy in 1842 by the permanent secretary, Baron de Walkenaer, who, in his appreciation of Rennell's investigation of ocean currents, pointed out that he was never wholly satisfied with his own work, which he continued constantly to correct and amplify, so that he became reluctant to publish results during his own life. In the 'Public Characters of 1803,' to which reference has already been made, Rennell is represented as tall and well made, with a countenance no less expressive of dignity and sentiment than of general benevolence. His simplicity, his courtesy, and his genius for friendship had indeed made him one whom all regarded it as a privilege to know.

After the death of Sir Joseph Banks and when age and infirmity were contracting the activities of this genial philosopher, the distinguished society of travellers, of *savants*, and men of the world who had held reunions in their houses and in those of a few mutual friends decided that the time had come to provide some means of perpetuating such occasions for social intercourse. And so it was that a group of Rennell's most intimate friends founded a dining club which received the name of the *Raleigh*. Among them were Sir Arthur Broke, the organizer, Admiral Smyth, Colonel Leake the topographer of Greece, Franklin the arctic explorer, Cam Hobhouse the friend of Byron, Marsden, Roderick Murchison, Captain Beaufort, Basil Hall, Mountstuart Elphinstone, Sir George Staunton, and many more; worthy successors of the old fellowship of the Mermaid Tavern. It was at a meeting of the Raleigh Club, barely two months after Rennell's death, that the decision was taken to found a Geographical Society, and less than two months later four hundred and sixty Fellows had already been enrolled. The Raleigh Club, which assisted at the birth of the Society, became in due course the Geographical Club. There can be little doubt that Rennell had during the last weeks of his life been interested in the project which his intimate friend Admiral Smyth and the Secretary of the Admiralty, Sir John Barrow, had simultaneously elaborated.

Of Rennell's two sons the elder, who had some talents of an artistic order, lived a retired life in the country. The second entered the Bengal Civil Service and died in India at the age of thirty-eight. It was his daughter Jane who

inherited his tastes and much of his ability. Having been his constant companion and assistant, she was well equipped to become his literary executor and superintend the publication of his posthumous volumes. She married in 1809 Captain, afterwards Rear-Admiral, Sir John Tremayne Rodd, whose long and varied experience at sea was of great service to Rennell in his hydrographic studies. To their children the veteran geographer particularly devoted himself in his latter years, and his letters to his grandson at a private school and afterwards at Eton, which are in the possession of the writer of this memoir, show how well he understood the art of being a grandfather. Those who believe in the transmission of inclinations by heredity will be interested to note that in the year preceding the centenary of his death the Founder's Medal of the Royal Geographical Society was awarded to his great-great-grandson, Francis Rennell Rodd, for his surveying work in the central Sahara.

By abstemiousness, exercise, and regular habits Rennell succeeded to a great extent in overcoming the constitutional weakness resulting from his wounds and fevers in India. But with advancing years he suffered repeatedly from an acute form of gout, which kept him for long periods confined to his bed or reclining on a sofa. A fall from a chair at the end of 1829, which caused a fracture of the thigh, finally precluded him from any further physical activity, and he died in his eighty-eighth year on 29 March 1830. He was buried in Westminster Abbey in the middle of the nave opposite the West Cloister door. An inscribed stone over the grave and a bust on the window-ledge of the Belfry Chapel under the north-west tower commemorate the Father of English Geography.

RENNELL RODD.

BOUNDARY WORK IN THE BALKANS: *A paper read at the Evening Meeting of the Society on 10 February 1930, by*

COLONEL FRANK L. GILES, D.S.O., O.B.E., late R.E.

I. *The Yugoslav–Bulgarian Boundary*

THE Yugoslav–Bulgarian Boundary Commission was created under the Treaty of Neuilly and began to function in 1920. It was composed of military representatives of France, Great Britain, Italy, Japan, Yugoslavia, and Bulgaria.

The line of the boundary between the two countries was defined by description in writing in the Treaty and shown on a map annexed thereto. Starting from the Danube in the north, the line follows the thalweg of the Timok river for a few miles, and then strikes across the broken country of the Danube valley till it mounts the Kom Balkan, east of Zaječar. This is a well-defined ridge 6000 feet high with steeply sloping wooded sides and forms an excellent geographical frontier.

Between Caribrod and Dragoman the line crosses the main railway from Belgrade to Sofia and again rises by well-defined spurs till it reaches the sugar-loaf peak of Ruj, some 6000 feet in height. Thence it cuts in a southerly direction across the upper Trn valley and again follows an easily distinguishable watershed until opposite Kyustendil. Here the line cuts off the upper Bosiljgrad valley from its economic outlet to the east and thence swings south-east and again south-west in a sort of " S " curve until reaching Dizderica. Here it leaves the watershed, and descending by a clearly marked spur of the northern side of the Strumica valley it cuts in a straight line across the river of that name to rise by a similar spur to the crest of the Belasica mountain range, where at a height of between 6000 and 7000 feet it meets at Mount Tumba the point in common to the three countries, Yugoslavia, Bulgaria and Greece.

Speaking generally, the boundary may be said to be geographically good, as wherever possible it follows some clearly marked topographical feature, for preference a watershed. Owing to the mountainous nature of the country no confusion of interpretation ever arose, nor did the question of the division of villages present any difficulty, as the average Balkan village consists of scattered huts spread over as much as 20 square miles of country. Difficulties only concerned isolated properties which lay on opposite sides of the boundary to their owner's main possessions. The Commission proposed a system of special *laisser-passer*, but this was not accepted by the interested parties, and, in point of fact, the question of regulating access to these properties is even now still in an unsettled state as between the Yugoslav and Bulgarian Governments.

Many of the mountain ridges along which the frontier runs are covered with forests of beech, pine, or dwarf oak. Here the line was demarcated by blazing the trunks of trees over 12 inches in diameter. Anything smaller than this was cut down to ground-level for a width of 5 metres on either side of the line.

In open country and in cultivated and inhabited areas boundary pillars of concrete were erected, each pillar being intervisible from that on either side of it, its geographical position being fixed by the method explained in the

Keep of Turkish fortress at Belogradčik in Danube valley

Rock erosion on River Cem near Podgorica

The Albanian Alps of the northern boundary

Snow-water lake in North Albanian Alps

appendix. By this means in the event of destruction its site can be re-determined accurately.

The Treaty specially laid down that if a difference occurred between the map and the text, the latter was to hold good. This proviso seems curious, since the text must have originally been compiled from some sort of map and presumably this map would be the origin of the map which was attached to the Treaty. One can only suppose that those who drafted the Treaty were intent on eliminating possible errors in reproduction between the original map on which they worked and that which was printed with the text. The possibility that the original map was inaccurate in itself does not seem to have been thought of; but from this cause there were many amusing instances of confusion, of which the most typical was the case of two villages in the Strumica valley which for the purpose of illustration may be called A and B. The text gave A to Serbia and B to Bulgaria. On the Treaty map A was some 5 miles west of the new boundary line, whilst B was an equal distance to the east of it. On the ground, however, the Commission found that B was in reality 10 miles west of A, and in order to comply with the text the boundary line would have had to make the most impossible curves instead of following the straight line which had evidently been the intention of the framers of the Treaty.

A straight line was the obvious and common-sense solution, especially as the villages, their inhabitants and their lands were of the poorest. Unfortunately the Treaty specified that no modification of the line was permissible without unanimity amongst the Commissioners, and there lay the crux of the problem. The Serb protested that A was the most valuable and fertile along the whole frontier, and he simply could not give it up. The Bulgar stoutly affirmed the same for village B. He also appealed to the text of the Treaty, which in this case was of course entirely favourable to his country. Nothing that the non-interested Commissioners could say would make them budge, and six months of diplomatic correspondence were required before the Conference of Ambassadors in Paris decided that the frontier should be a straight line and that the text should be altered accordingly.

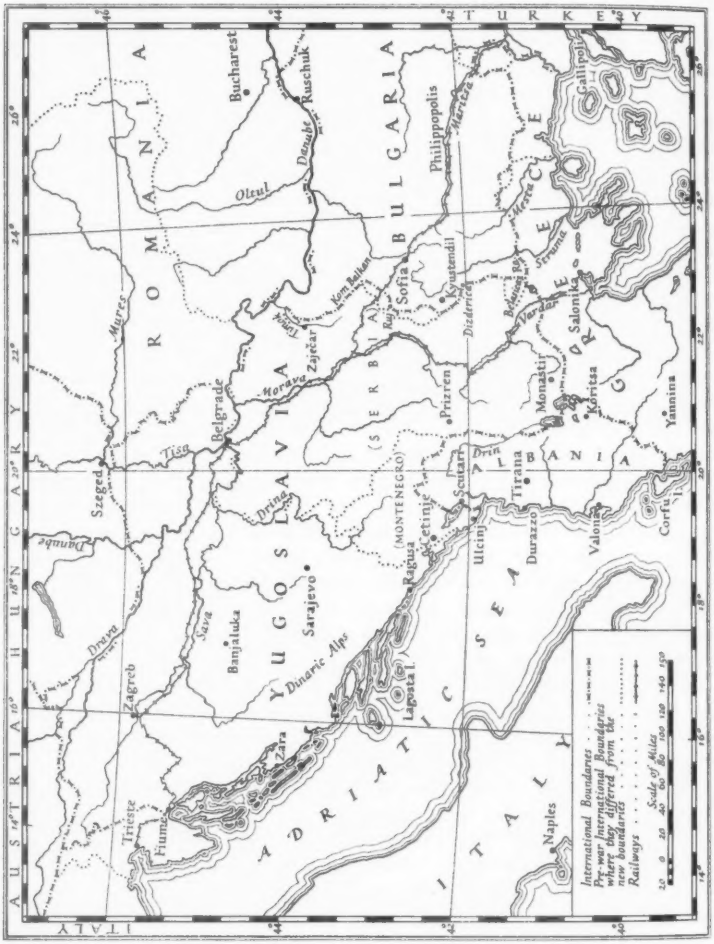
Spot heights were freely used in the Treaty to describe the line of the boundary, and, although the actual heights were found to be as much as 600 metres wrong, no confusion in identifying the points occurred, thanks to the bold relief of the ground over which the boundary passes.

The first meetings of the Commission were held in Paris in August 1920. In October, in company with the Greco-Bulgar Commission, we proceeded to Salonika, and from there climbed the 6000 feet of the steep and barren slopes of the Belasica range to the north-east of Lake Doiran to fix the point in common to the three countries. But, owing to a dispute of a similar nature to that which has been described above, no definite decision was reached until a year later.

From Salonika the Yugoslav-Bulgar Commission journeyed to Sofia and fixed its headquarters there. It was then decided, in the absence of any map sufficiently accurate for the purpose, that a survey of 5 km. width on either side of the boundary on a scale of 1/25,000 should be made by the survey parties of the interested governments, and on this the line should be plotted.

The framework of this survey was based on the triangulation which had been

carried out before the Great War under the able supervision of General Bošković, Director of the Serbian Geographical Service. Bulgaria had nothing in the way of trigonometrical records except figures produced by Russian topographers after the Russo-Turkish War of 1878, and the points on the ground



from which these figures were calculated had long since disappeared or been dug up by the local peasant, who got it into his head that the Russian surveyors were burying treasure on the mountain-tops.

The advent of winter suspended operations until April 1921, when a reconnaissance of the frontier from the Danube to the Belasica was carried out by the Commission *en bloc* and the siting of the boundary pillars was settled on the

spot. The frontier was then divided into four sections, and each section was placed in charge of a non-interested Commissioner whose task it was to supervise the construction of the boundary marks and the cutting of the boundary lane through the forests.

Each non-interested Commissioner camped on his section throughout the summer of 1921 and had with him a survey and constructional party from each interested country as well as a jurist to assist in settling any legal questions that might arise. No boundary mark of a permanent nature had ever existed on this frontier prior to the arrival of the Commission; so, in addition to the concrete pillars on the new portions of the boundary, the interested States on their own initiative erected similar beacons along those portions which had not been altered by the Treaty. In this way 575 concrete pyramids have been built along the 536 km. of the Yugoslav-Bulgar boundary. For each pyramid there is a descriptive chart which shows its coordinates, the distance to each pyramid on either side, and a large-scale sketch of the site on which the pyramid stands.

For diplomatic reasons which cannot be entered into in a paper of this nature, the Commission did not complete its labours until December 1922, although the technical work on the ground and reproduction of the map and documents in the drawing and printing office were ready for publication a twelvemonth earlier. The final dossier of records was prepared in triplicate, and one copy was placed in the hands of each of the interested countries, while the third copy was deposited with the Conference of Ambassadors in Paris.

II. *The Albanian Boundary*

The Albanian Boundary Commission, unlike all other international frontier commissions in Europe after the Great War, was not born of a peace treaty but was the child of the Conference of Ambassadors.

Albania was first recognized by the then Great Powers as an independent State after the Balkan wars of 1912, mainly at England's instigation. At the Conference of London in 1912 a rough outline of its proposed territory, carved out of what had been Turkey in Europe, was drawn up, and two Commissions representing the six Great Powers were sent in 1913 and 1914, one to the north and the other to the south, to determine the exact line on the ground and to erect suitable boundary marks. As may well be supposed, this boundary was defined in very vague terms, and was based on political rather than ethnographical or geographical reasons. To give a history of the political motives involved would entail divulging secrets contained in the pre-war archives of most of the Chanceries of Europe.

The outbreak of war in 1914 cut short the work of both Commissions, and some idea of the difficulty of communications in those parts at that time may be gained from the fact that the news of the declaration of war did not reach the Northern Commission until four days after its occurrence. Naturally neither Commission had had time to complete any survey or erect beacons in a country where no accurate map existed nor any civil registration of ownership of properties.

The experience of a brother officer, Lieut.-Colonel King, who was one of the two surveyors attached to the Southern Commission, is worth quoting. He had forty-eight hours' notice to prepare kit and equipment before leaving England.

He therefore arrived in Albania with a 3-inch Vernier theodolite, a steel tape, and a plane-table, and was asked to produce single-handed within three weeks a survey of a strip of territory 50 miles wide and 100 miles long for which there were no trigonometrical points nor any map more accurate than that of the explorer's variety.

His task entailed measuring a base, triangulation, and filling in of detail on plane-table, to say nothing of having to attempt to make flag and chainmen out of the local peasant whose language he did not understand. Not unnaturally he failed to complete the work given him, although he nearly killed himself in the endeavour. But his efforts were not wholly wasted, since his results were the only data with any pretensions to accuracy which the 1922 Commission found in the archives of the Geographical Institute in Florence.

Colonel King's opposite number, a German officer, was in even worse plight, since he arrived unhampered by a survey instrument of any description. He therefore concentrated his efforts on enlarging the totally inaccurate map published by the Austrian General Staff in 1911 and corrected by eye the errors which the enlargement had already greatly magnified.

Owing to the threatening attitude of the local inhabitants this Southern Commission withdrew to Florence in December 1913, and there drew up a description of the Greco-Albanian frontier by the aid of these very rough surveys, and their labours were baptized as the Protocol of Florence.

The question of the Albanian frontier then lay dormant until 1920, when the Albanians asked for a neutral International Commission to delimit and demarcate their frontier in North-Western Macedonia with the newly formed kingdom of Yugoslavia, owing to the friction which had arisen between the two countries in this area. With the agreement of the two interested parties the Conference of Ambassadors appointed for the purpose a commission composed of military representatives of Great Britain, France, and Italy. Japan waived her right to be represented. Technical work was carried out by survey parties from Yugoslavia and Albania, and very fortunately the officer in charge of the former, Colonel Stojanović, had held a similar position on the Yugoslav-Bulgar Frontier Commission. This officer is an exceptionally able surveyor and organizer and would be a credit to any topographical service in the world. Albania, having no surveyors of her own, hired a party from Italy, and very good work they did, too.

The survey sections worked under the orders of the Commission, and the experience gained on the Yugoslav-Bulgar frontier proved so helpful that the instructions and organization adopted in Albania are taken as a basis for the figures and data in the appendix of this paper.

As advisory to the Commission, each interested country nominated a delegate whose functions not only included the presentation of his country's claims but also the arrangements for food, transport, and security whilst the Commission was on his territory. At first the Commission moved without any military escort, but after the murder of the Italian delegation near Yannina in 1923 a large detachment of soldiers was supplied by the country in which the Commission happened to be living. When moving backwards and forwards across the frontier, an escort from each country secured the safety of the Commissioners. Thus the total numbers sometimes amounted to 500 persons.

Hercegovinian shepherdess

An Albanian village

Commission crossing snow slope in Albanian Alps

Camp at 3000 feet in valley in Albanian Alps at 6 a.m. on a July morning

Lake Okhrida from 6500 feet

Frontier ridge at noon on the same day

The Commission began work in Florence in February 1922 at the Military Geographical Institute over which General Vacchelli so ably presides. Three weeks were spent in searching the archives for any records left by the Commissions of 1913 and 1914, but nothing was discovered except the minutes of what must have been very stormy meetings at which no decision was ever arrived at. The only find of any value was the survey by Colonel King to which reference has already been made.

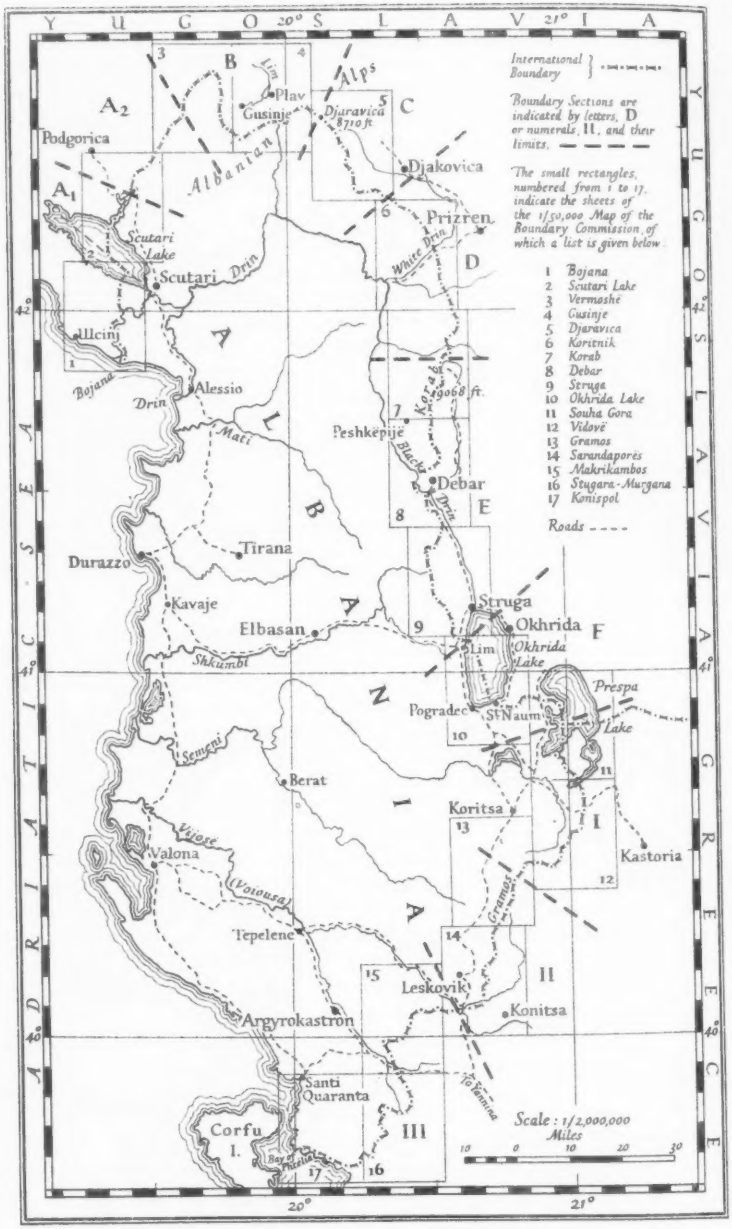
The Commission crossed the Adriatic in March 1922 in a destroyer placed at its disposal by the Italian Government and took up its headquarters at Scutari, a town of 30,000 inhabitants at the southern end of the lake of the same name. The mixture of religions and races here is remarkable. Muhammadan, Orthodox, and Catholic rub shoulder to shoulder in the streets, each in their distinctive dress. Plainsmen walk cheek by jowl with mountaineers, who bristle with revolvers, cartridge belts, rifle, and knives. These Malissores, to give them their Albanian name, are the tribes amongst whom Miss Edith Durham's name is one to conjure with. The physique of the men is magnificent. The women are notable for the deep leather belts they wear, covered with plates of iron.

The tribes are purely pastoral and live in the plains in the winter, migrating in the summer-time with all their possessions, including even the woodwork of their houses, to the mountain pasturages of the Albanian Alps to the north. The primitive nature of their existence must be seen to be believed. On one occasion the Commission was quite innocently misled by a claim to a certain valley on the grounds, so said the chief, that the tribal church was built there. The church proved to be but a wooden cross planted in the ground, with four posts in front on which was balanced a flat stone to form an altar. The walls were the surrounding mountains and the roof the sky above.

The Albanian Alps are of limestone formation and are not unlike the Karst topography of the Dinaric Alps which form a backbone to the coast of Dalmatia. Rivers such as the Lim emerge as torrential springs at the foot of cliffs 2000 and 3000 feet high. Mountain lakes with no ingress or egress of water are found at the higher levels, but fortunately the frontier in no case was complicated by passing across such terrain. The average height of the peaks is from 6000 to 8000 feet, and snow lies from October to May above the 6600-feet level. The topmost heights consist of bare pinnacles of rock rising sheer many hundreds of feet above their bases, and are inaccessible except to a properly equipped and skilful mountaineering party. The local name for this territory is Prokletia, which means, literally, a damnable country, and the experience of three summers spent there fully endorses the nomenclature.

The line of the Albanian frontier starts in the north on the Adriatic shore, crosses the lake of Scutari, and follows a well-defined crest-line northwards for 30 m. It then turns eastward as far as Mount Djaravica. Here it makes a right-angled bend southwards, cuts across the valley of the White Drin, west of Prizren, and follows the knife-edge-like ridge of the Korab (9000 feet) and Deshat chain as far as the town of Debar, where it crosses the valley and river of the Black Drin and runs along a series of crests to the village of Lim on the west shore of Lake Okhrida.

Crossing the lake, the line of the frontier leaves the Monastery of St. Naum



The Boundaries of Albania

to Yugoslavia and traverses the 6000-feet ridge separating the lakes of Okhrida and Prespa. In the latter lake is the point in common to Albania, Yugoslavia, and Greece. Continuing in a semicircle, of which the centre is the town of Koritsa, the boundary reaches the Gramos Mountains south of that town and follows the crest-line for 30 m. till cutting across the valley of the Voiousa river. It then bends westwards and its trace is arbitrary, following watersheds wherever possible, but cutting across several large valleys until reaching the bay of Phtélia on the Straits of Corfu. The trace of this portion of the frontier is entirely arbitrary and presumably was based on political motives.

After completing the reconnaissance of the northern frontier in June 1922, the Commission embarked again at Scutari and sailed down the Adriatic to Santi Quaranta, passing Durazzo and Valona *en route*. The ruined battlements of the former stare stiffly out to sea, a striking witness to its former Roman and Venetian owners and to the fact that it was the western terminus of the Great *Via Ignatia* which led via Elbasan, Okhrida, Monastir, Salonika and across Thrace to Constantinople. Portions of the old Roman paving of this highway may still be found intact both in Albania and in Macedonia.

From Santi Quaranta the Commission proceeded by car to Koritsa and reconnoitred the eastern frontier, which was inaccessible directly from the coast. Owing to diplomatic difficulties as to the ownership of the monastery of St. Naum at the southern end of lake Okhrida, no further progress was made with the technical work in 1922. During the sojourn at Koritsa the Commission ascertained that no beacons existed along the Greco-Albanian portion of the frontier, and reported accordingly to the Conference of Ambassadors, who gave them the responsibility of building boundary marks from Lake Prespa to the Straits of Corfu. No work being possible on account of snow in the winter months, the Commission broke up in December 1922 and re-assembled at Koritsa in May 1923.

The frontier was then divided into sections and, after drawing lots, the northern section was supervised by the French Delegation, the British took the east, and the Italian the south. Each Commissioner was responsible for the construction of the beacons in his own section and for ensuring that the technical instructions of the Commission as regards surveying and fixation of each boundary pillar were complied with as described in the appendix.

In August 1923 the whole of the Italian Delegation was murdered near Yannina, which gave rise to the Corfu incident. The underlying causes for this disaster obviously cannot be discussed in a paper of this nature. It is sufficient to say that again work was at a standstill until a new Italian Delegation appeared on the scene in October 1923. The eastern boundary had been completed by this time, and a small portion of the northern.

After the massacre the Commission had orders from Paris always to move in a body together and never without an armed escort. This last condition sometimes gave rise to awkward situations, such as when the Italian Commissioner attended divine service in a Catholic church at Corfu and his two Greek detectives insisted on sitting one on either side of him. Progress was naturally much hampered, and the Commissioners began to realize from their personal experience what must be the feelings of crowned heads and criminals.

The Greco-Albanian frontier was completed on the ground by December 1923. After the winter recess work was resumed on the northern frontier in May 1924, and the Jugoslav-Albanian portion practically completed that summer; but diplomatic disputes prevented a conclusion being reached until another two years had elapsed.

Meanwhile the maps and documents in connection with the Greek portion of the frontier were drawn up in triplicate at the Geographical Institute in Florence, and a copy handed to the interested countries and the Conference of Ambassadors in December 1924. The summer of 1925 saw the completion of all technical work in connection with the Yugoslav–Albanian frontier, but the final documents were not signed, and the Commission was not dissolved until August 1926, four and a half years after its inception. During these four and a half years the composition of the Commission had completely changed, with the exception of the French Secretary, who remained faithful to it throughout.

APPENDIX

NOTES ON THE TECHNICAL WORK OF THE ALBANIAN BOUNDARY DEMARCATION

Triangulation and Topography

To provide points for the topographers along the Yugoslav–Albanian frontier the Commission made use of the Yugoslav triangulation. This is based on the pre-war Serbian Trigonometrical System, which in turn originated from and checked up with the Austrian. It had been extended in 1920–22 into Macedonia, and for control purposes four bases had been measured with invar wires. Of these one is near Monastir and the other near Prizren.

This system was therefore extended across the Albanian frontier, breaking down to points of second and third order. The network of triangulation only reached the district of the lakes of Okhrida and Prespa, and it was originally intended to use the Greek triangulation for the Greco-Albanian frontier. But when the geographical coordinates of certain points in common to the two systems were compared, a considerable divergence was discovered. It was therefore decided to extend from the Yugoslav system a framework of second, third and fourth order points as far as the Straits of Corfu, and by this means ensure uniform control for all the trigonometrical work along the whole of the Albanian frontier.

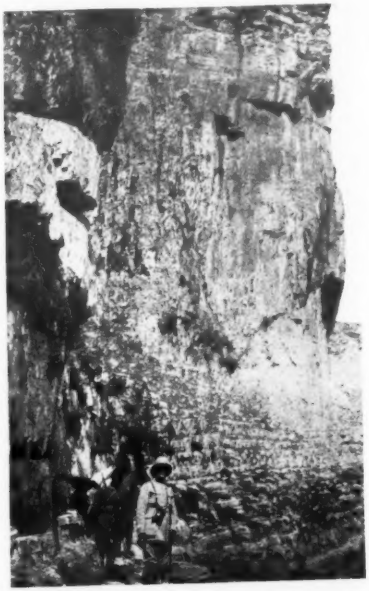
Heights were based on the Yugoslav lines of levels which intersect their country and are most accurately measured. One of these lines ends at Struga, at the northern end of the Lake of Okhrida, and the other at Prizren. The origin of this vertical framework is a point on the Sartorio pier at Trieste. Calculations were based on Clarke's Figure of 1880. The meridian of Paris was the origin of longitude.

At every 20 to 25 kilometres along the frontier a boundary pillar was tied in to the trigonometrical system and observations made to establish its geographical coordinates and height.

After the work had been completed in the field a table of coordinates of all trigonometrical points established on the frontier was printed, together with a map on 1/1,000,000 scale on which every point appeared. This formed part of the final documents.

The topographers used plane-tables of the usual type measuring 40 × 50 cms., and telescopic alidades with vertical arc and two magnifiers, reading to 30″. The

Shuttering for casting the boundary pillars



1000-foot vertical rock face in the Albanian Alps

First beacon on the Albanian frontier

Scale 0·54 of original

FRONTIÈRE DE L'ALBANIE

Section *A*

Sous-section *2* **Borne N.** *15*

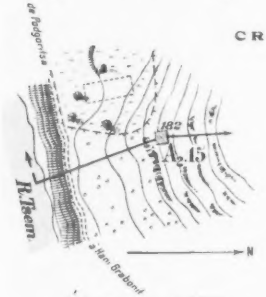
Coordonnées géographiques de la borne
(si elle est reliée au réseau trigonométrique)

Altitude *182 m*
Longitude
Latitude

TOUR D'HORIZON DE LA BORNE

POINTS VISÉS	ANGLES	DISTANCES	OBSERVATIONS
Borne arrière (A_2 14)		479 m	Maison sur la rive droite du Tsam
Borne avant (A_2 16)		1482 m	
Maison sur la rive droite du Tsam (angle gauche)	0° 00′ 00″		Rocher vers le N.E
Rocher caractéristique vers le N.E par lequel passe la frontière.	128° 06′ 00″		
Rocher caractéristique vers le Sud	281° 52′ 00″		Rocher vers le S.

CROQUIS EXPLICATIFS.



Échelle appr : 1.1000

Descriptions:

La borne A_2 15 est située sur un socle de roche à l'angle N.E de la clôture limitant le champ en amont de la maison sur la rive droite du Tsam, à 1000 m. environ à l'O de Ham Grabovit

De la borne à la maison il y a environ 20 m.

Ech 1.50000 Éq 20 m

Description de la frontière de la borne No. A_2. 15 à la borne No. A_2. 16

En partant de la borne No. A_2. 15, la ligne frontière monte en direction N.N.O. par un éperon abrupt et un peu buissonneux pour arriver, après 600 m. environ, à une falaise dont elle suit l'arête en direction N.E. pendant 600 m. environ. De là, elle tourne vers le Nord et gravissant un autre éperon escarpé et rocheux elle atteint, au bout de 400 m. environ, la borne A_2. 16

Signatures of the Surveyors and of the Commissioners

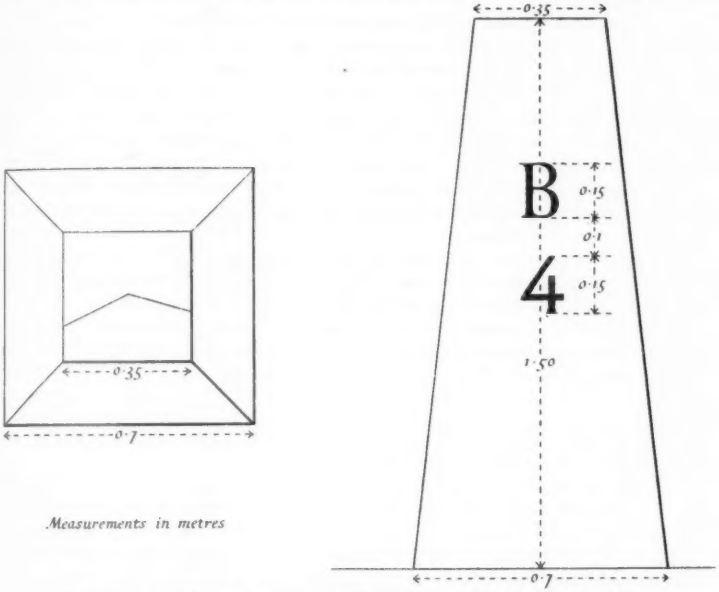
FORM OF DESCRIPTION OF BOUNDARY

telescope was optically good and powerful. The diaphragm held three horizontal and one vertical wire. This instrument, in conjunction with tacheometric staffs, was used in normal country suitable for tacheometric methods. A telemeter, or rangefinder, with 1-metre base was invariably used in the mountainous regions. Its probable error was ½ per cent. up to 1000 metres.

The *regle calcul*, a species of slide rule graduated logarithmically, was used for calculating heights and, in conjunction with the telemeter, distances.

Demarcation

The frontier was divided into sections, of which a certain number were allotted



Measurements in metres

Diagram showing the form and dimensions of the boundary pillars

to each Commissioner for supervision of construction of boundary pillars, of which the sites had already been selected by the Commission as a whole. Each Commissioner was accompanied by a sub-delegate from the interested countries through whom orders and instructions were given to their respective survey and construction parties.

The boundary pillars were made of concrete mixed on the spot. Their form and dimensions are shown. Each pillar bore laterally the initials of the country towards which it faced. On the rear side was cut the alphabetical letter of the section and the serial number of the pillar. On the top were sunk lines indicating the direction of the pillar next on either side. A larger pillar was built to mark the point of each change of section.

Pillars were normally intervisible, but where the boundary followed an inaccessible knife-edge mountain ridge they were at times as much as 4 or 5 kilometres apart. Every change of direction of the boundary was marked by a pillar.

A sheet was prepared for every pillar, by which its geographical position was

accurately recorded as a precaution against removal or destruction in the future (see Plate 12).

Map of the Frontier.

The final accurate survey of the frontier comprised a zone of 1 kilometre width on either side of the line, drawn on 1/50,000 with contours at 20-metre intervals. Each sheet, of which there were twenty-eight in all, was of 18 minutes side. A general outline map of the country on a scale of 1/500,000, showing the detail of the frontier and indicating sections and sheets, was also produced as a kind of index chart. The Istituto Geografico Militare in Florence carried out all printing and reproduction.

The knotty question of orthography was settled as follows:

The basis of the spelling of place-names was French phonetic pronunciation. A list was prepared by the Commission of every name appearing on each field sheet, and the interested delegates were asked in turn to pronounce each name according to the Slav, Albanian, or Greek pronunciation. The name was then written down by the French secretary to the Commission according to his phonetic conception of the pronunciation. If, as often happened, two interested delegates gave totally different names to the same topographical feature, the Commission adopted the name proposed by the delegate of the country in which the feature was situated.

Spelling of important and well-known names, *e.g.* Scutari, was retained as having been fixed by general usage, even though it might not correspond exactly to the name in use by the local inhabitants.

All documents connected with the frontier were printed in triplicate. One copy was handed to each interested government, whilst the third was deposited in the archives of the Council of Ambassadors in Paris.

Statistics

The total length of the Albanian boundary is 734 kilometres, of which 477 border Yugoslavia and 257 march with Greece.

Three hundred and fifty-seven boundary pillars are built along its frontier, of which 137 are between 0 and 1000 metres above sea-level; 173 are between 1000 and 2000 metres above sea-level; and 47 are between 2000 and 3000 metres above sea-level. The highest point on the frontier is Mount Korab, on the eastern side, over 9000 feet above sea-level yet not more than 50 miles from the Adriatic.

These figures give an idea of the practical difficulties encountered in the construction of the boundary pillars when it is remembered that at the higher altitudes even the water for mixing the concrete had to be brought up by pack-horses from the valleys many thousands of feet below. Moreover, the eastern frontier between Okhrida and Prizren traverses a table-land over 6000 feet in height where there is no living creature of any sort over a length of 50 miles and a breadth of 20 miles.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: It is some considerable time since we have had a lecture on the continent on which we all have the honour to live, that is to say, Europe; and we are very glad that Colonel Giles is here to-night to give us an account of his boundary work in Yugoslavia, partly because, as I have said, we have not heard much about Europe recently, and partly because there are not very many of us who have been to Yugoslavia. Boundary work in Asia and Africa has been a very fruitful source of new geographical work. Boundary work in Europe can hardly hope to present the same advantages because, after all, we do know a good deal about this continent. On

the other hand, boundary work even in Europe brings new aspects before us and gives us the opportunity of learning something in detail of the frontier regions.

Colonel Giles, who is going to lecture to-night, was, until recently, Military Attaché at Belgrade and Athens and at Prague, and before that he was the British Commissioner on two boundary commissions: the first the Yugoslav–Bulgarian Commission and the second the Yugoslav–Albanian Commission. In that capacity he represented this country and had every opportunity of studying what very few of us have had the opportunity of learning, namely, the intimate geography of those frontiers.

Colonel Giles then delivered the lecture printed above, and a discussion followed.

The PRESIDENT: Clearly this Society does not deal with politics. Though some questions in the Balkans are of political interest I hope no speaker will touch on political matters. We should like to hear Dr. Pouritch, the *Chargé d'Affaires* of the Royal Legation of Yugoslavia.

Dr. POURITCH: I should like to thank Colonel Giles for the very interesting lecture he has given us this evening. For many years Colonel Giles represented very gallantly the British Army in Yugoslavia; he was very popular and well known throughout the country; even the children in Belgrade knew him, and he has proved this evening that he is thoroughly familiar with the subject of the lecture—so much so that even we Yugoslavs have learned many things we did not previously know. So I have to thank him once more.

Mr. H. CHARLES WOODS: I feel it is rather dangerous for me to speak because I have a way of dabbling in Balkan politics, but I promise I will not do so to-night. There are four points on which I should like to touch. First, I must support, very strongly, what Colonel Giles has said with regard to the variations in climate in the different areas. In the Balkans I have sometimes been almost frozen at night and within a few hours I should have been glad to bathe in the sea. This, of course, is usually due partly to the different elevation and partly to the heat of the sun. Secondly, I quite agree with the speaker that all these peoples would like to be governed by the country which would collect the fewest taxes from them. I am quite certain that in Albania, as elsewhere, a great many of them would like to have the Turks back largely because they do or did collect their taxes very irregularly.

Thirdly, those who know Albania and who have travelled there would perhaps think that the speaker this evening had not accentuated sufficiently the reputation gained by Colonel Phillips in Albania. In 1913 and 1914 Colonel Phillips was really the Representative of Europe in Scutari, and after the war he again held various appointments in Albania. If this country has a reputation in Albania it is partly due to such people as Miss Durham, Sir Henry Eyres, and Colonel Phillips. As a traveller in Albania I think that in justice to them this point should be accentuated.

Fourthly, I do not know whether Colonel Giles inferred that it was necessary to go by sea from Scutari to Santi Quaranta in order to travel from the north to the south of Albania. The roads are of course indifferent, but at the present time one can motor a good deal, at any rate in the western part of the country. Three years ago I did 800 miles by car in ten days or a fortnight. I will not say it is possible to motor up to the Yugoslav frontier, but you can certainly motor from north to south of the country in decent weather.

Major SUTTON: The communications, at least in Eastern Albania, are very difficult. In Western Albania it is possible to travel from north to south by motor car; in Eastern Albania it is not possible under present conditions. Actually, when going from the north to the south, 20 miles would take one or more days. Main

roads from north to south and also the lateral roads east to west are, in places, only 6 inches wide. I would like to add that there are places in Eastern Albania which are of great interest, but are, I think, practically unvisited and unknown to any Western European. There are certain early Christian churches which have not been excavated. I know some of the sites, and there is a field for those who wish to dig and ascertain what is underneath. Although it is an extremely difficult journey to get through from Western to Eastern Albania, the journey can be made quite easily through Yugoslavia.

The PRESIDENT: The boundaries described to-night so admirably by Colonel Giles are of particular interest to this Society because, as I dare say many of you realize, the maps on which those readjustments of boundary were made in France after the war were actually constructed by the Royal Geographical Society. The large series of maps on the scale of 1/Million were drawn at the instigation of the Geographical Section of the War Office, by a band of voluntary workers under the direction of this Society, and were laid, drawn and printed by the Ordnance Survey at Southampton. It was on those 1/Million maps—that great series covering the whole of Europe and a great part of Nearer Asia—that the readjustments were actually made. On the maps which we are discussing to-night there is a note to the effect that the basis of the map was drawn by the Service Géographique de l'Armée Britannique, which means that the sheets were compiled by the Royal Geographical Society for the War Office. I think of all the things the Society has done that was, perhaps, the most useful for the world at large.

Now with regard to Colonel Giles' lecture, I think we must all of us have envied him his experience in those delightful countries. Of course there were minor hardships and difficulties, and I understand the food was not always up to the mark. But we realize that the countries discussed are singularly interesting, and the work was of real importance. Colonel Giles carried out the work, as we know, in conjunction with his colleagues, extremely satisfactorily, and the fact that the high authorities are satisfied with what was done is the best testimony to the admirable work which the Commission carried out. We thank Colonel Giles for his lecture to-night, and we congratulate him on the success of his labours.

THE CLIMATIC CONDITIONS OF THE TARIM BASIN:

A paper read at the Afternoon Meeting of the Society on 17 February 1930, by

LIEUT.-COLONEL REGINALD C. F. SCHOMBERG, D.S.O.

THE Tarim Basin is the name given to the great amphitheatre of plain, largely desert, that is girdled on three sides by the Kunlun and Tien Shan mountains, and which forms the most valuable and important part of the province of Sinkiang, or Chinese Turkistan. These notes put forward a few observations made in a two-years journey in the country.

The conditions generally have led some travellers in Chinese Turkistan to believe that in recent, certainly in historical times, the climate of this region has been greatly modified, and that a marked increase in aridity has taken place: briefly, that the country is drying up. In proof of this theory, the remains of extensive towns, especially of Loulan, the diminished length of the Keriya and other rivers east of it, and the decrease of water in the Lop Nor, are all cited. The Turfan depression has also been brought to witness as having had a very different climate from its present one. (There was a note on this in the *Geographical Journal*, 72, 357, October 1928.) It has therefore been argued that in the Tarim basin a continuous and appreciably rapid process of desiccation has been going on, caused by failure of water as evidenced by the phenomena above quoted. An endeavour will be made in this paper to modify this proposition.

The theory of desiccation has been chiefly built on the aridity existing in a district stretching from the Keriya river inclusive to the eastern boundary, where the Niya and other rivers have decreased in length, and where several sites of abandoned towns have been excavated in the desert. Here it is well to make it clear that the writer has never been east of Khotan or south of Tikenlik in the lower Tarim. It is generally admitted that at no time was the population east of Keriya other than sparse, and that the whole of this small corner of a large province is, and has been, a barren and forlorn area, occupied only by gold-miners and convicts. Conditions therefore prevailing in this part of Sinkiang cannot be regarded as typical of the rest of the province. Such an assertion would assuredly be far fetched. It is also difficult to believe that the climate should have changed here, and not elsewhere—or, to put it differently, that the decreased flow in rivers east of Keriya should be caused by climatic rather than by other natural causes.

There is one theory that deserves mention. As all rivers in Turkistan are fed by the melting snows, it has been suggested that the Keriya and other rivers have failed to obtain their supply, owing to the coating of debris, detritus, or other deposit covering the glaciers, or even to actual decrease in the glaciers themselves. Yet no decrease whatever has yet been observed in the neighbouring Khotan river.

It is hoped in this paper to put forward other causes for the diminished flow in the rivers of this area; and to bring to bear on the subject observations made elsewhere.

Swinburne was no geographer, or he would not have said that even the weariest river winds somewhere safe to sea. There is probably nothing so

striking geographically in Central Asia as the ubiquity of drainageless basins, which vary from basins so large as almost to lose their individual character, such as the Aral or Caspian seas, to small cups in the mountains or shallow lagoons in the plains. The whole of the Tarim Basin south of the Tien Shan is of this character, but so too is the Dzungarian region north of those mountains. Both these immense districts are similar in many respects; and it is thought that the behaviour of the rivers in both places explains at once the

Sketch-map to illustrate Colonel Schomberg's paper on the Tarim Basin

decrease in the waters of Lop Nor as well as the gradual disappearance of the Keriya and other insignificant streams to the east.

It is significant that south of the Tien Shan, although there are several minor depressions and drainageless areas, the lakes formed are comparatively trivial. There are the fresh and salt lakes of Lop Nor—these should be kept distinct, as no water from the north is likely to reach the salt-water lake in the Lop depression; and the lake in the Turfan area. The Baghrash Köl or Tenggris Nor near Qara Shahr is a true lake. Thus south of the Tien Shan with a greater water supply there are markedly fewer lakes, and this difference can be attributed to irrigation and the porous nature of the soil.

The Tarim is the name given to the aggregate of rivers that fall into the main stream of the area. This great stream centuries ago fed Lop Nor, whose shrinking and exiguous waters point either to a failure of supply in the Tarim; or, what is more likely, a failure of the Tarim water to reach the lake.

The chief river north of the Tien Shan is the Manass, a very large and imposing stream, but not the equal of the Tarim. The behaviour of this river is worth attention. It leaves the cultivated area of Manass and flows through extensive swamps and backwaters, overgrown with reeds and jungle, and fringed with dense forests of toghraq, elm, and other trees. The right bank of the river is often a high and dangerous cliff, and from the top the traveller looks over a waste, impassable as it is impenetrable; and through this territory the Manass has made for itself many new channels, a process of which it never wearies.

For years the Manass fed the Telli Nor (lake), reaching it through swamp and morass just as the Tarim ages ago reached and fed Lop Nor. But the Manass is now abandoning the Telli Nor, and in April 1928 there was not a trace of moisture in the lake-bed. It was possible to ride everywhere over it, and very exhausting work it was, for the going was heavy. At that time of the year the river was not full, and the people, who said the lake was drying up, said that later a little water would reach it. The remains of canals and lines of trees at the northern end of the lake bore witness to a departed period of irrigation. It was due to no lack of water in the river that the Telli Nor was degenerating into a mere dismal depression and a mass of flickering mirage. Its cruel fate is caused by the Manass leaving it. The river has already turned to the east, and as time goes on it will form another lake, unless with the fickleness of all these Central Asian rivers, it turns once more to its former channel.

This seems to have been the fate of Lop Nor, as a brief examination of the state of the Tarim river will show. The Tarim alone is mentioned, as no one suggests that the Keriya and its diminished neighbours had any influence on Lop Nor, always excepting the Charchan river, not even in the happy days when a slight trickle from the Keriya occasionally found its way to the Tarim. It seems very doubtful if the former river flowed perennially as far as the latter, since there are practically no remains of man in its northern half.

In the behaviour of the Tarim the secret of Lop Nor must be sought. The rivers of Turkistan depend wholly on the snow which usually varies little, although it sometimes happens (as in the winter of 1928–29), but without affecting the argument, that the fall is excessive. Taking however the average winter, the rivers begin to rise in April when the first melting snow comes down. The greater part of the water is taken for irrigation, and it is very rarely that a river is untapped after it reaches the plains. So much is this the case that in the height of the season, the season of highest water and intensest cultivation, many rivers—the Kucha, for example—are but a mere trickle; the whole volume has been deflected into the fields.

In April and late autumn, when the first and last snow water comes down, the rivers are practically untouched for irrigation, but at both these periods, owing to the diminished melting on the high peaks, arising from colder weather, shorter days, and in autumn less snow, the rivers never carry their full capacity, and so the full force of the current is now never felt in the Tarim.

As the cultivated area of the Tarim basin has greatly increased of late years, for example between Maralbashi and Yarkand, the fields are almost continuous, though Sir Aurel Stein's map of twenty years ago shows many gaps; so year by year more water is taken for irrigation and less reaches the rivers. A comparison with Turkistan as it is now, with the account given by Mr. A. D. Carey of his journey in 1885 (Proc. R.G.S., N.S. 9, 731; Dec. 1887), will still further support this point and emphasize the contrast. The difference is really amazing.

The flood water has in fact been decreasing for fifty years, as the irrigated land has extended. A brief glance is necessary at the nature of the country watered by these rivers. The plain of Turkistan consists of a soft friable soil, and there is thus nothing to control or guide the rivers as they roll down into the plains. When they reach this level yielding plain, there is no hill, no rock formation, no immovable forest, to curb their will: unrestrained and unchecked, they wander aimlessly through this monotonous region. Indeed, it is remarkable that they do not roam more freely.

Flowing north from the Kunlun, until stopped by the Tien Shan, which turns them east, the rivers are again diverted by the Quruq Tagh, and finally find their grave in the Lop district. Throughout their course, they lose volume steadily, through irrigation and in the immense marshes, swamps, and backwaters which they form as they go. It is true that their affluents are important. The chief is the Aqsu, which took two hours to cross in August 1929, and others are the Muzart and the Kucha; but the toll of irrigation from both these tributaries is severe. It is however south of Kucha that the Tarim begins to lose volume as lagoons, lakes, and bogs absorb its water.

Mr. Rickmer Rickmers, in his lecture before the Society in April 1929 (*Geogr. Journ.*, vol. 74, p. 213), remarked that he cherished the belief that the riddle of the dead cities of Chinese Turkistan was to be sought amongst the Pamir glaciers, and added that nothing warranted a zone of rainfall cultivation for the Tarim basin. A brief digression with reference to the rainfall will settle the latter point. The average rainfall at Kashgar is 2 inches, and the influence of rain may be disregarded in discussing the climate of Southern Sinkiang. It is generally agreed that in recent centuries there has been no change in the rainfall. To show how dependent the whole country is on irrigation, it is interesting to note that not a single piece of unirrigated cultivation was seen anywhere south of the Tien Shan, whether in the plain or in the hills.

To take Mr. Rickmers' other point, it is presumed that he means that the Tarim river has decreased in volume owing to a decrease in snow and glacier in the Pamirs, thereby causing the Tarim to fail to reach Loulan; and it is Loulan, after all, which is the largest of the derelict cities in the whole country, and compared with which the other cities are negligible. When the Quruq Darya ran dry, the water turned more southerly and formed the lower Tarim. The process of drying up in Lop Nor meant the same process in Loulan, for the fate of lake marshes and city was the same.

Now, however, the Quruq Darya has again come to life, and in process of time perhaps Loulan too will be habitable. This great change must rule out any diminution in snow-fall or glacier formation in the Pamirs, as it indicates that Loulan came by destruction, not through an altered climate but through

Dead toghraqs on the banks of the Qum Darya

The Qara Köl river south of Maralbashi

The Qum Darya near Yingpan

Tamarisk cone near Tikenlik

Toghraqs growing in sand by the left bank of the Manass

Dead and living tamarisks near Ordeklik on Kashgar–Maralbashi road

riverine vagaries. If it can be shown that Loulan was abandoned because the river left the course to which it has now returned, the case against a climatic change as the causative reason must be in part established.

It is interesting to note that Professor Ellsworth Huntington ('Pulse of Asia,' pp. 280 *et seq.*) mentions a period of increase in Lop Nor in the middle ages, which perhaps indicates the time when the Quruq river definitely flowed for the last time. In the *Geographical Journal* for December 1929 there was a note on the recent fluvial changes in the Tarim Basin, but perhaps it is desirable to amplify in this paper the recent events in the eastern part, so as to indicate clearly what is happening.

Until five, or perhaps six, years ago the Tarim, reinforced by the Konche Darya, a most important stream, flowed south through Tikenlik and so into the swamps of Lop Nor. At that time the greater part of the Konche river water was lost in the Chong Köl and Tais Köl, and the main river was a comparatively narrow stream, some 40 yards wide, when it flowed near Tikenlik into the Tarim. The Tarim river, too, carried in its lower reaches in those days a comparatively small proportion of its proper volume. The result was that both the Konche and Tarim rivers had lost the greater portion of their volume by the time they had reached Tikenlik, with the result that the flow at the Lop Nor end, but not to the lake itself, was correspondingly scanty.

The present condition of affairs is very different. The Tarim has turned more east, taken the Konche Darya with it, and has flowed into the Quruq Darya, now the Qum or Yangi (Sand or New) Darya; with the result that the combined volumes of the two are now much greater than they were before after their union at Tikenlik. The Chong and Tais Köl are still full, but their water is now diverted to the new river, as is manifest from a glance at the attenuated Yarkand river, as just at this point the Tarim is called, flowing close by, lower in level than the lakes, and deriving no benefit therefrom.

The new river, flowing past Yingpan, forms an immense swamp south of Altmish Bulaq, making it impossible to reach Loulan from the west; indeed, it is difficult to say how Loulan can be approached, except from the east. If, therefore, the new river remains faithful to its bed, and if it can extricate itself from the swamp, it is a fair presumption that the Lop Nor marshes will become a considerable lake, but not the present salt lake. The unhappy people at Tikenlik, Daral, and Yangisu, the settlements on the lower Tarim, are now suffering the lot of the Loulan people when their river capriciously turned elsewhere.

The Yangi or Qum river itself was a remarkable stream in October 1929, broad and powerful. As it rolled along it tore down forests of dead toghraq, and undermined high sand-hills. Day and night the thud of falling sand sounded in the silent air, as the river restlessly rolled hither and thither, scouring new channels for itself out of the great shallow bed of its age-dead predecessor. Delicate patches of new reed were replacing the grey remnants of a thousand years ago, and a gradual but definite change was taking place in the environs of the Quruq Darya. The river had gone down considerably, for it was October, and a month previously it must have been an even more wonderful spectacle. As it was it was truly inspiring, and the reflections it evoked gave an added glamour.

Having thus discussed the present state of the Tarim, it is worth while noting the conditions in the Quruq Tagh, as this small offshoot of the Tien Shan has been regarded as a victim of the effects of desiccation, and as having played a part in the destruction of Loulan. Sir Aurel Stein—for no paper can dispense with his admirable and well-reasoned observations—remarks that he found the Quruq Tagh less dry than he had anticipated. A journey in October 1928 in these mountains left Sir Aurel's route at Singer, and passing beneath the Heita Shan (Black Head or Big Black Mountains) joined his route at Shindi. The country was pleasant, and certainly the name Quruq or Dry was a misnomer, as indeed the people at Kurla had already told us. Brushwood and grass were ample, the toghraqs abundant and well grown, and vegetation generally good. Indeed, the conditions were far better than in the lower valleys of the Southern Tien Shan, and at Heita Shan the water was copious. The snowfall is heavy in the Quruq Tagh, and although the soil fails to retain much water, the verdure is considerable. It is remarkable, too, that the Quruq Tagh is the winter pasture of the Khoshut Mongols from Qara Shahr.

Speaking generally, it would not seem likely that the Quruq Tagh had ever any effect on the fate of Loulan: it is difficult to see how it could; still less that it shows any climatic changes, though the visit was admittedly brief and observation cursory.

The rivers of Turkistan, owing to their circumstances, appear subject to erosion and to sub-soil changes, and the effects of both react on the country in the vicinity, leading to serious dispersion or loss of the water supply. It is accordingly suggested that the real explanation of the shrinking of the Keriya and other rivers must be sought in local influences of such a nature.

The process of erosion may be pictured as follows: A river carves its way in the soft desert soil, and the water at first is near the surface. The cultivator comes, and starts to irrigate; but gradually the water eats into the soil, the level falls, the fields become unirrigable, and the peasant departs elsewhere, leaving his fields behind him. To the uninitiated these marks tell their sad tale, of withering rivers and homeless men, of ruthless desiccation, and a harsh drying clime.

The next development in the river is the formation of backwaters, caused by the high eroded banks falling in, and gradually being silted up in the narrower parts with fallen trees and brushwood to aid the process. Good examples of this were evident on the left of the Yarkand river, south of the main Maralbashi–Aqsu road, where there was a maze of backwaters and old channels, often hidden by forest, with abandoned fields and irrigation cuts. All this is more easily understood if it is realized that the most trivial alterations will have considerable results in the soft friable soil.

Sub-soil changes accompany erosion, but are frequently distinct. The soil in Sinkiang is very porous, and often incapable of retaining the water. In Hami (Qomul), in the hills north of Kucha, near Uch Turfan and Kona Turfan and elsewhere, the tendency of streams issuing from the foothills is to lose themselves in the sandy plain, often but not always, reappearing again at a lower level. This action is common enough everywhere, but it does explain much in Sinkiang. For example, in the very well-watered Yai Döbe plain, north of Faizabad, in the Kashgar district, the water supply is always altering. Several

villages marked in the maps have been abandoned, owing to failure of water which has come to the surface again in other parts of the plain.

At Tang Toghraq, 40 miles north-east of Maralbashi on the main road, the results of both erosion and divagation of the water are evident. There half the cultivated area is in good workable order. The other half has been abandoned, as the erosion first made the level of the water too low, and then caused the supply to fail, which prevented all tapping of the stream higher up. It was noticeable as new settlements were being made some way off, where the water was more accessible.

In the southern slopes of the Barköl Mountains the streams would disappear at the point where they reached the plain, and either reappeared a great deal farther on, 15 or more miles away, or else vanish.

So too the Karez system of the Turfan depression demonstrates the presence of abundant sub-soil water—every year new Karez are being made, and the latest series is at the western extremity of the depression, near Bejantura, which will alter the whole character of the present arid plain. An even more remarkable case is the Algoi Sai, a beautiful mountain stream which vanishes completely into the desert to reappear 25 miles east, at the settlement of Toqsun, west of Kona Turfan.

There are two small points connected with the effect of aridity on vegetation in Chinese Turkistan to which brief reference is necessary: the value of the toghraq and the tamarisk as evidence of defective moisture. Sir Aurel Stein has remarked that the tamarisk can never exist without moisture, and although careful watch was kept, in no place was a tamarisk found where it could be said that the ground was true desert. Either occasional or periodical water is essential for tamarisks. The toghraq (*Populus balsamifera*), or desert poplar, appears to be less sensitive to aridity, and better able to resist drought. The argument from these two plants in favour of aridity is drawn from the dead and not living organism. It is a common sight to see forests of dead toghraqs, gaunt and melancholy, thrusting their barren trunks starkly through the cloying sand. But although failure in the water supply usually kills them, they can die from other and not always easily distinguishable causes. Near Chilan, on the main Aqsu road, there is a forest of these dead trees, killed by a flood. At Aqsaq Maral, south of Maralbashi, there is a grove of dead toghraqs, with a belt of living tamarisk close by. The inference is that the water disappeared and killed the trees, it then returned later and enabled the tamarisks to grow. As it is the habit of the toghraq to grow in sand, the cause of its death must, as has been just said, often be obscure.

The tamarisk cone, whose age has been ably estimated by Sir Aurel Stein, has often some perplexing habits. It is often difficult to tell why plants have died, especially when new seedlings are found growing in the humus of long-dead cones. Again, there will often be a number of these cones scattered over a plain, all of them rotted; yet between them will be found abundant tamarisk, often growing comfortably in the protection of their defunct kinsmen. As the tamarisk grows, after surviving with some trouble the fierceness of the dust-storms, or "Burans," it collects round its roots sand, leaves, and other dejecta; and this hill of debris rises with and finally stifles the plant, if the latter is not killed by lack of water.

Sometimes there is a plain covered with dead tamarisk cones and also with a luxuriant growth of new low tamarisk. Owing to the age and state of the cones, and the small size of the new growth, it would appear that there was an interval between the death of the one and the advent of the other, and this predicates subterranean water changes, as the neighbourhood seldom shows any alteration in itself. These two references to the toghraq and tamarisk indicate that these, when dead, are not a certain sign of permanent aridity subsequent to their growth, though of course in certain places the dead toghraq plants are but the inevitable result of the desert's victory.

To summarize the remarks in this paper. Climatic changes in the Tarim Basin have been based on two distinct and unreciprocating features: (1) the drying up of Lop Nor and the destruction of Loulan; (2) the increased aridity east of Keriya. Owing to the fluvial changes in the Tarim Basin and the rejuvenation of the Quruq river, the evidence drawn from the first point needs revision. The argument for the second appears too vague and certainly too local to be applied with any force to the rest of the province; and the withering of the rivers can be explained by causes observable in many parts of the country. It may be noted parenthetically that in the south of the Punjab whole rivers have vanished, to flow elsewhere. It is admitted that the district east of Keriya, although now more populous and cultivated than before, is drier than the rest of the country, and this is a predisposing cause in itself, for sub-soil and erosive changes.

The river system of the Tarim Basin must remain an ineluctable problem, as the nature of the swamps and jungle, lagoon and river, makes true exploration impossible. Even an aeroplane would be useless, as the depth of the various sheets of water, the identification of the true river, and its separation from some vagrant tributary, could not be arrived at from the air.

Let a poet who never saw Central Asia describe accurately how the rivers of that distant region flow: a remarkable description indeed of the Tarim:

> He flowed
> Right for the polar star past Orgunjé
> Brimming and bright and large. Then sands began
> To hem his watery march and dam his streams
> And split his currents, that for many a league
> The shorn and parcelled Oxus strains along,
> Through beds of sand and matted rushy isles,
> Oxus—forgetting the bright speed he had
> In his high mountain cradle in Pamere,
> A foiled circuitous wanderer. MATTHEW ARNOLD
> (*Sohrab and Rustum*).

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: Colonel Schomberg is going to give us a paper this afternoon on "The Climatic Conditions of the Tarim Basin." Colonel Schomberg has seen much service in India and has always taken a great interest in Central Asia. He has spent some years in the Tarim Basin, the Tien Shan and neighbouring regions, and has some important observa-

tions to make on the much-discussed question of the alleged desiccation of that part of Central Asia. We shall be glad to hear what he has to say about it.

Colonel Schomberg then read the paper printed above, and a discussion followed.

The PRESIDENT: Mr. Hinks has received a letter from Professor J. W. Gregory; I will ask him to read it.

Mr. A. R. HINKS: Professor Gregory expressed great regret that he could not be present to-day because he had read with so much interest Colonel Schomberg's preliminary note, but he sends this contribution to the discussion:

Colonel Schomberg's valuable contribution to the geography of the Tarim Basin, amplifying his note in the *Geographical Journal* for last December, should be a useful correction of the view that West Central Asia is undergoing desiccation through a still progressive climatic change. That theory has been advocated by so many eminent Asiatic authorities—including W. T. Blanford, Kropotkin, Major Molesworth Sykes, Sir Aurel Stein, and Professor Ellsworth Huntington—and it offers such a simple solution of many facts, and is so attractively interesting and dramatic, that it has naturally been popular and persistent. In a paper in the *Geographical Journal* in 1914 I pointed out that the theory had been rejected by other authorities, such as von Richthofen, Tietze, Berg and Sven Hedin, and quoted evidence that there has been no progressive desiccation of Baluchistan since the time of Alexander the Great, or in the Tarim desert since the eighth century. I also quoted F. Grenard, who explained the apparent increasing desiccation of the Tarim Basin as due, not to a diminution in the flow of the rivers but to changes in their course, and that such changes had happened in the time of the Han dynasty. References to these authorities are given in the *Journal*, 43, 1914, pp. 293–8.

Colonel Schomberg's convincing record of contemporary changes of the kind adduced by Grenard should be most useful.

The Tarim Basin is the area for which there is the weightiest testimony in favour of material progressive desiccation. Colonel Schomberg's proof that the theory is there unnecessary and inconsistent with the facts is a most welcome contribution to the discussion.

Dr. H. R. MILL: Anything connected with rainfall or the absence of it, or with the flow of rivers and formation of lakes, has always been of the utmost interest to me, and, if I had the necessary knowledge of what work has been done previously, I would like to deal in some detail with the points which Colonel Schomberg has laid before us. Professor Gregory has given in his letter such a clear and succinct account of existing and older theories that it is not necessary to attempt to deal further with these.

I gather that Colonel Schomberg's view of the variation of the rivers is that the climate of the region has remained unchanged, and that the difference in aridity and in suitability for maintaining a population depends upon natural changes in the course of the streams. That the rivers of Central Asia are erratic as to their course we all know very well, and some of the variations are of enormous magnitude, like that which took the Oxus away from the Caspian and turned it into the Aral Sea. Such changes must necessarily make a great difference in the level of the lakes into which the rivers ultimately flow, or from which they are cut off, but it is difficult for me to understand how irrigation alone can have had so great an effect in the Tarim basin as Colonel Schomberg appears to have found. He spoke of the porous nature of the soil and of rivers disappearing in one place and reappearing in another. He spoke also of the variation of the stream, but did not give any account of the mechanism by which that is accomplished. Is it due to the rivers being fuller of water at one time than at another, giving rise to floods

following on periods of low water? If so, how can the variations in volume be accounted for except by variations in the amount of precipitation on the snowfields feeding the glaciers or variations of solar heat melting the ice which supplies the waters for the rivers? Such variations mean change of climate. Again, if the rivers do not vary irregularly in volume, how do they change their course? What else can cause them to forsake their old bed and form a new one except some kind of climatic change? The increased power of erosion in a river implies an increase in the volume or in the gradient or both. Where the gradient is slight the variations must be in volume, not necessarily as progressive drying up, but perhaps as successive diminutions and increases, following changes in precipitation which may have a very long period.

I should like to know the range of the swing of the rivers from side to side of the region and whether this is determined by the level of the land. Is the surface soft and sandy to such a degree that it is impossible in any case for something resembling a canyon to be formed as is usual in other arid districts? The only explanation that I can see for the extreme variability of a river course in a fairly constant climate is that there must be very little difference of level over a large area, and I cannot see how a great expanse of level country could arise in arid conditions unless in the beds of ancient lakes within which all the modern wandering of the river takes place. In that case there must surely have been some change of climate to account either for a vast loss of water by evaporation, or for an excess of water at some earlier time, due either to greater precipitation on the snowfields or greater melting of the glaciers. It remains to consider whether these changes occurred in what may be termed geological times rather than within the human period.

Every theory suggested on this point brings up a whole crop of other problems, and it is most encouraging that it should do so, for if these new problems were not continually forthcoming what hope would the Royal Geographical Society have of anything approaching immortality? We have often been told that when this or that discovery has been made the Royal Geographical Society may close its doors. There is no tendency at present to do this. After a hundred years of activity we require not to close but to open new halls and libraries to receive the ever-increasing flow of geographical results. We look to keen observers like Colonel Schomberg for the information that will keep our new hall lively and fill our library with memoirs as interesting as that which we have just had the pleasure of hearing.

Mr. HINKS: I should like to ask Colonel Schomberg how the tamarisk reproduces itself. Is it by seed, or by creeping root stems, or how? It seems to me that a little knowledge of that would be very helpful to discussing this point.

Colonel SCHOMBERG: I think largely by seed, but I am not a botanist. The only question to answer in connection with the points Dr. Mill raised is as to how the rivers change their course. I think I observed that in regard to the Quruq Darya the most notable thing was that day and night the erosion of the banks was going on. The whole country of the Tarim Basin is really sand. The result is that the erosion is a phenomenon very easily arrived at. Quite a small flow of water erodes steadily the whole time. Here you have the new river, the Yangi or Quruq Darya. You had it falling, the water daily getting less and less, and yet erosion continued the whole time. I think my answer to Dr. Mill—I do not pretend that it is a complete one—is that it is due to the soft friable nature of the soil. There is nothing to retain the river. The smallest current, the most normal gentle stream, carves for itself a new bed with the greatest ease. Of course the desert is not flat by any means. There are many tablelands and various hills caused chiefly by the action of the wind which changes the face of the whole of the desert. But, generally

speaking, these hills are no obstacle. There was this new river tearing down huge sand-dunes—great sand-dunes that even the storms of Chinese Turkistan must have taken many years to form; the river was falling, yet in its vast bed, it was tearing down these sand-hills as it went along.

As to canyons, I can remember none on the flat plain of Turkistan. As soon as a river has burrowed a bed for itself the tendency is for the walls of sand to fall in and fill up the trough it has formed, and the river has to struggle on as best it can, and usually forms a new channel either on its right or left. The whole of the soil of the Tarim Basin is so soft, it is so easily influenced by any fluvial action, that changes occur with the greatest ease and on the slightest possible provocation. I am afraid I cannot pretend to reply to Dr. Mill's other learned remarks.

The PRESIDENT: Colonel Schomberg has given a suggestive and valuable scientific paper. I thought, when I had the privilege of reading the proof, I had better turn up what M. de Martonne said in his book on internal drainage areas, and I find that he says a certain amount about the Tarim Basin; it is interesting to see that the Tarim is itself a part of an immense area which stretches right across Central Asia, Arabia, across Africa to the Atlantic. It is a huge almost continuous area of internal drainage. In M. de Martonne's book you will find several descriptions of different types of internal drainage areas, notably two: those which have rivers and those which have not. M. de Martonne points out that there are two maxima, if we take the parallels of latitude for these areas, in each Hemisphere: the area in both Hemispheres which is occupied by these regions is almost entirely comprised between 20° N. and 50° N. and 20° S. and 50° S. Europe and North America are fairly free. Of course there naturally is an immense block in Australia, but in the main, on the Earth's surface, the most important block is that stretching from Central Asia across Arabia and Africa to the Atlantic. M. de Martonne says, very sensibly, that it is impossible to draw any general conclusion as to why those areas occur, though some of the causes are, undoubtedly, very local, as our lecturer said. But there is no question that there is some very general cause which would apply to that whole region.

Colonel Schomberg has given us clearly to understand that those old simple ideas of a general drying up of Central Asia are extremely doubtful; in fact, he would say that they are untrue as regards the Tarim Basin. It would be interesting, if we could, to have a series of accounts like this at intervals, say, of ten years and see what is happening. We really want a series of scientific papers like Colonel Schomberg's; and a hundred years from now, those who follow us would probably have a better idea as to what is really happening. Colonel Schomberg has given us an admirable paper, and in the name of the Society I beg to thank him.

FURTHER NOTES ON THE SHORE TOPOGRAPHY OF THE ENGLISH LAKES

MR. THOMAS HAY

[Two years ago the author read a paper at an Afternoon Meeting of the Society on "The Shore Topography of the English Lakes" (*G.J.*, 72, 1928, p. 38). We have now received the results of his further investigations on the lake-shores. It will be remembered that in the earlier paper the boulders which line the beaches of the lakes are described as the most striking feature of the whole lake-shore scenery. In many places, where the slopes are steep down to the lake-side, like those of Place Fell beside Ullswater, the author agrees with Dr. Mill that the boulders have clearly rolled down the hillside on to the shore. Where however the slopes, formed of boulder clay, are gentle, like those of Glencoin on Ullswater, the boulders must be the heavy remnants of moraines, the rest of which has been washed away by wave action cutting into the fellside. Where the valley is lined with boulder clay to a great depth, stream erosion reduces the shore-line to a series of bays and rounded promontories which at first sight resemble deltas but are distinguishable from them by the irregularity of their surface line. To this third type of shore, common in many places on the lakes and clearly defined, Mr. Hay has given the name of the Watermillock type.

In his earlier paper the author pointed out that the movement of material along the lake margin, which has an important influence on the shore topography, is determined by the direction of the predominant wind on each lake. In areas of hard rock movement is practically confined to the shore near stream mouths. Streams entering the lake through a delta often curve towards the wind, even when this means that they curve towards the head of the valley. The edge of the delta is also sometimes higher on the windward than on the leeward side, where there is often a low-lying water-logged stretch. Many of the larger deltas appear to be nearly dormant, with small subsidiary deltas growing at the mouths of the stream.]

Wastwater

WASTWATER is a particularly attractive lake, from the point of view of the problems belonging to its margin. The outlet is quite peculiar. The lake, which runs north-east and south-west, has its south-western end partially blocked by a beautiful wooded hill of Buttermere granophyre, which leaves a scanty exit for the water on its south-eastern side at the foot of the steep cliff range of the Screes. This narrow exit has been further cramped by a huge dry delta fan on the south-east side and one or two subordinate ones coming down from the north margin of the Eskdale granite which here meets the granophyre. The consequence is that the scree slope has shallowed up the escape of the water, and it would be a very easy thing for a huge waterspout on the Screes to close up the exit altogether for a time. A kind of lagoon has been formed above this shallowing, as a tailpiece to the lake, and here the flow of water is sluggish and slime and water-plants appear, in contrast to the rest of the lake, which is very clear of such growth.

Shore of granophyre blocks, Wastwater

The mouth of Over Beck, Wastwater

Scarfeclose Bay, Derwentwater

Lingholm Island, Derwentwater

The entrance to the lagoon from the lake is narrowed by a unique mole of stones running out from the south-east shore. This mole is composed of material about the size of road metal, apparently more or less uniformly of that size. It is 110 yards long, 18 yards wide, 4 feet 6 inches high on the lake-side, and has a back slope of 3 feet. Behind it, within the lagoon, there are several projections of gravel providing little natural docks for boats. About halfway along the south-east shore the configuration of the land is further complicated by the fact that there has been a bloomery here, and the nature of the mounds is only revealed by the discovery of buried cinders.

Leaving the lagoon and proceeding north-east along the lake, at the mountain foot and over a piece of bare scree, the next part of the shore is of Mellbreak type, executed in Borrowdale rock, *i.e.* it is a continuous old scree covered by a scanty growth of grass and occasional dwarfed shrubs, and always very steep. The cliffs overhead are magnificent in their wild grandeur. So far there has been a small narrow rocky shore with boulders placed anyhow and not aligned. But now the great scree is reached, where there is no track at all, merely a great

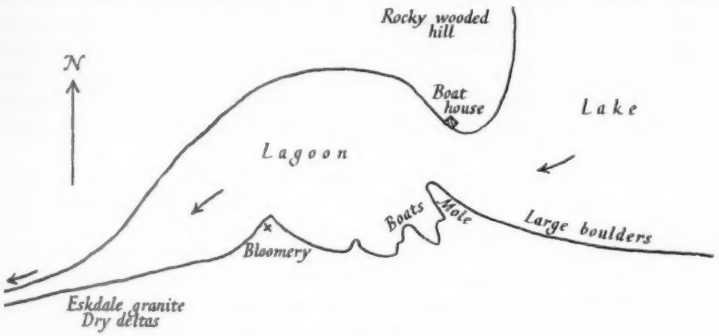


Fig. 1. The outlet of Wastwater

slope of boulders of all sizes and shapes, descending at the same angle of about 35° right into the water, without margin or shore of any sort. There is no appreciable change in slope between the old covered scree and the bare scree, but the latter is alive, so to speak, and continually liable to movement.

On the north-east of "Great Broken," as the principal scree is called, the same features continue, except that the hardly noticeable track recommences and crosses the lesser screes. Here and there a detached block stands out in the water, clear of the slope, but there is still no beach.

This scree shore of Wastwater is unique, and the reason for such an immense collection of loose material in this one place is not at all obvious. The four following points are offered as first suggestions: (1) Along the whole length of the scree slope there is not a single stream. The water-parting between Wastwater and the Burnmoor valley is very near the former. (2) The Borrowdale mass of rock here may have been severely crushed between the huge mass of the Eskdale intrusive granite to the south-east and the Buttermere intrusive granophyre to the north-west. (3) According to the geological map there is a great

number of intrusive dykes along the scree slope. These dykes, numbering nearly a score, may have provided lines of weakness. (4) The valley would be cleared from ice at an early stage after the general retreat of the ice-sheet, for though the scree slope faces north-west, it gets the full brunt of the powerful late afternoon sun in summer.

After a second spell of Mellbreak type, the impending cliffs recede, the scree slope is grassy, and a sloping beach appears. The first point of live rock is not reached until we are two-thirds of the way along the lake. A small patch of Boulder Clay, with rounded boulders on the shore, occurs before the deltas at Wasdale Hall are reached. There is a good beach right round a curved bay and then a great deltaic spread of gravel by the farm. The stream has two or three distributaries on the downlake side.

There is movement of gravel up-lake here. A wire fence has caught detritus and raised it 8 or 10 inches. At the head of the lake there is a great collection of shingle, forming one of the largest beaches in the whole district. It stands 4 feet high and is raised in rough steps by the gales. There is a back slope of 3 feet. A distributary from Lingmell Gill has brought down a great deposit of detritus. The whole rim to this end of the lake forms a most impressive storm beach. Toward the river mouth it is backed by a rough marshy field and there are spits of gravel and sand growing out irregularly, also pools formed by the vagaries of the storm beach deposits. So great has been the quantity of material brought down by Lingmell Gill that behind the beaches it forms a large grass-covered sloping dry delta.

Directly the main stream is crossed, just where the old footbridge has fallen to decay, a depth of 14 or 15 feet of glacio-fluvial deposit is found on the right bank. There is apparently a similar deposit near the mouth of Nether Beck, and this raises one of the most puzzling problems of these lake-shores. Such deposits occur near the upper end of Derwentwater, at the foot of Haweswater, in many places around Ennerdale, between Brotherswater and Ullswater. The deposit at the head of Wastwater probably points to a former higher level of lake and stream. This is a simple solution for this case, but it may not be equally applicable to other cases such as Ennerdale.

The opposite or north-west shore of the lake may now be traced, beginning at the exit. The hill on the right bank of the lagoon at the mouth is granophyre, but it has lain right in the way of the ice moving down the valley. There is some drift left on the slopes of this hill, so that the shore-line round towards the Hall is of the Glencoin type. There is a fair beach with a few travelled boulders. The whole shore near the house has been embanked. A little distance north-east of the house a rocky point of granophyre occurs and the beach disappears. A sloping meadow shows an old shore-line 9 feet above present level and a beautiful curving and shelving beach, largely granophyre, with a few big travelled boulders. The glaciated cliff where the public road reaches the lake-edge drops abruptly to the water and the beach ceases.

This granophyre shore-line from the outlet to the skirt of Middle Fell is very interesting and quite different from the other shores of the lake. Pockets of fine cement-like drift occur here and there, as if all the irregularities of the surface rock had been filled up. The edge soon drops lower and the rocks at the water-level have little projecting points with stony bays between. The angular

blocks above and below water are clean and free from sand and growth of any sort. Near the shelter the shore is strewn with great angular blocks of granophyre, with a fairly well developed surface system of jointing. This is shown in the rocky point near the shelter. One set of joints runs more or less north and south, and makes quite a distinct show both above and below water. Another set runs nearly at right angles to it. At another place one set of joints is nearly at right angles to the general line of the shore. Large blocks of material were thus ready for any plucking action that the ice may have exerted. In one place a great gap can be seen where a tooth of rock has been extracted. The very boggy nature of the thin earthy coating of the rock behind the shore suggests that there is little underground drainage, and thus a greater amount of surface disintegration. These two factors, ice action and surface disintegration, have in fact demolished the granophyre and left this curious block-strewn shore as a kind of disintegrated skeleton.

North-east of Countess Beck the same type of shore continues, rocky pro-

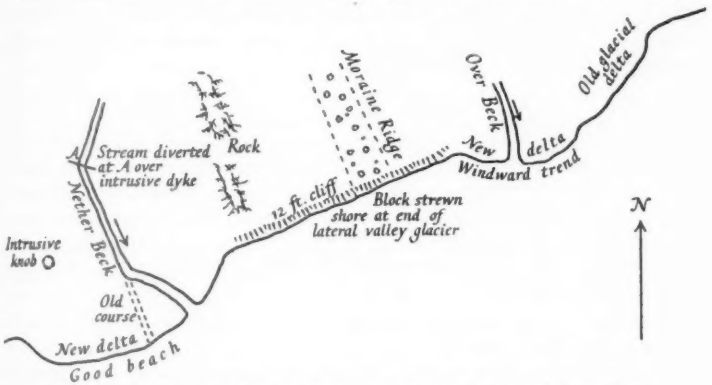


Fig. 2. Wastwater shoreline between Nether Beck and Over Beck

montories at right angles to the shore and stony bays between, and this continues when we pass from granophyre to breccia and tuff whilst proceeding under Middle Fell towards Nether Beck. The promontories under Middle Fell are bolder and the bays deeper, and the rock is often glaciated and now lacking the joints previously mentioned.

Just before the big delta of Nether Beck a curious little jagged rib of andesite runs down north and south, making a ragged outcrop on the shore. Two large gravel pits lie here on the left of the road; one consists of ordinary drift, but the other shows a good deal of current-bedded and rounded gravel.

We now come to one of the most interesting stretches of shore-line, that between Nether Beck and Over Beck. It is another huge accumulation of rock waste, but it seems to have originated in a different manner. At each end there is the modern delta at the mouth of the beck, and all the way along between is a wide block-strewn shore with a landward cliff 12 feet high clothed with vegetation and small trees. The two big valleys run up into the hills roughly at right angles to the shore, and between them there is a great whale-back descending

from the median fell and serrated along its backbone with jagged boulders. This looks like the weathered shape of a lateral glacier dump descending from the combined valleys of the Nether and Over Becks. The section of shore in question would thus consist of two deltas joined by a strip of boulder chute from a lateral glacier.

The stream in Nether Beck delta opens up-lake, but there is an old medial course and also indications of an older windward one. Over Beck has an opening showing the windward trend, and on its uplake side there is a great curve of an older glacial delta. The last piece of shore-line lies under Yewbarrow. It is straight, with boulder-clay slopes on the fellside and a stony and block-strewn shore. Although this is of Glencoin type, being cut out of boulder clay, it departs materially from the usual nature. There is not a wide beach, but only a 5-yards-wide shore formed of very rough blocky material with no small pebbles.

The outward appearance of these lakes has many features of common likeness, and yet on examination each lake has its own characteristics. Wastwater surely is one of the most individual, and its shores may be described as a museum of fragments from the surrounding mountains—a veritable rubbish dump of the so-called eternal hills.

Windermere

This lake, except for a small portion at the north end lying in Borrowdale and Coniston limestone rocks, has its basin completely surrounded by the Upper Slates. These Silurian rocks, as far as the beaches and cliffs of the lake-shores are concerned, give rise to features like those of the Skiddaw Slate areas rather than those of the Borrowdale areas. The rock disintegrates into flattish oval discs and eventually gives rise to a more plentiful supply of earth wash capable of supporting vegetation. The shores of the lake are frequently covered with growing plants to the very water's edge. This is in striking contrast with the shore of a lake like Wastwater.

The examination of the shore of Windermere is more laborious than might be expected owing to the length of the lake, the presence of many large houses beside it, and the density of the vegetation along its shores, which makes them almost impassable in places, and masks the origin and condition of the physical features.

Beginning at the head of the lake and proceeding along the east coast, all the land between the old Roman Camp of the Borrans and the water's edge of river and lake is alluvial, and it looks as if a water passage of some sort had been close against the camp wall on the west at some time. The recent land here is reedy and boggy, with reeds growing right out into the lake edge. This piece of shore is discussed in an additional note later in this paper.

Immediately to the east of the low alluvial land little ribs of Borrowdale rock run down southwards to the shore and enclose a tiny beach of mixed pebbles. The Waterhead embankment runs all round the corner and leads on to a strip of Glencoin type with rounded boulders on the shore. A small delta delivers down-lake.

Holme Crag is a bold but low rocky promontory where the Coniston limestone appears. There is a good beach on the south side and evidence of some wave action despite the shallow shore. Another wooded rocky promontory

leads to an east and west strip of shore where the margin by the roadside is well embanked, rock showing on the shore and also fine sand which is not at all common. The National Trust strip here gives one the first experience of a new type of shore which may be called the Windermere Type. It is cut out of boulder clay and is thus of the same origin as the Glencoin type, but instead of a wide flat shore there is a tangle of vegetation. Small alders, willows, ashes, hazels, and rank grasses grow here, and in this case provide a hiding place for the rubbish that visitors have left behind.

A tiny bay just north of Low Wood has been made by two vanished streams which have eroded the drift and entered the lake at the same point. There is a narrow beach of fine sand here. Just south of Low Wood there is a beautiful semicircular delta with up-lake delivery, grass and vegetation to the edge, and a row of willows and darkish blue pebbles from the Brathay flags. There have been down-lake openings to this delta which subsequently were blocked by an old stormbeach.

Following this there is a stretch of shore of the Glencoin type, wide and flat, with shrubs, and showing movement of gravel from the south. The shore pebbles now become more "stone" coloured. After a spell of the Windermere type, the shore again reverts to the Glencoin type, with a good deal of rubble used to bank up the margin. At Ecclerigg Crag there is a bold rocky promontory formed by the Coniston grit and falling abruptly to the water without any beach.

Rounding this point one enters a wide square-headed indentation between the point last described and the Calgarth land which occupies the right bank of the huge delta formed by the Trout Beck. The shallow shores of this rectangular bay are bordered by marshy alluvial land except near Ecclerigg Crag. At the head of the opening there is a wide expanse of level yellow alluvial clay cut by drainage dykes and showing an old lake-shore at the foot of the slope behind. Over the wooded north-west corner of the delta a long levee in cement is built out through the marshy and reedy ground to reach a boathouse. The bulk of the right half of the delta is rough grass land, and Dr. Mill has called attention to the evidences of wave action shown at its edge. There would be no need to mention the matter further were it not for the fact that the shore-line is the express object of this paper and it may not be convenient for the reader to refer to Dr. Mill's Articles on the Bathymetrical Survey of the Lakes in the *Journal* for July and August 1895. Judging by the outline of the delta quite a noticeable segment has been wiped out by wave action. Along this edge coarse grass grows to the water's edge, and a jagged succession of tiny bays shows a foot-high cliff of yellow clay at the side and a correspondingly small beach of fine sandy gravel at the head.

After this great delta, which shows the windward trend, the slate rock descends in easy knolls to the shore, with pockets of boulder clay. A very flat grassy shore then occurs, followed by a stretch of wooded Glencoin type, with some large boulders. At Millerground there is a fine beach of small gravel followed by a dense strip of Windermere type along the foot of Adelaide Hill. Rayrigg Wyke is a small square-headed bay, reedy and boggy, with a grassy promontory on the north, and on the south a good flat delta built out by Mill Beck. Close at hand on the south another tiny beck has built out an alluvial

stretch opposite Lady Holme. This grassy shore with scattered trees and slate pebbles has some huge boulders at its south end adjoining the wooded promontory of Fallbarrow. Bowness Bay has a good gravel beach where the boats and boat-houses allow it to be seen. Cockshot promontory is formed of gently rolling land with rounded glaciated rock as a framework, nearly everywhere covered with undulating grass and probably with pockets of boulder clay. On its southerly inner angle is seen a specimen of one of the principal features of Windermere. The glaciated rock is planed off and rounded on the north side, whilst on the south side it is rough and abrupt where plucking may have taken place. This feature is developed on a great scale in the promontories on the west side of the lake.

One would have expected more evidence of wave action on the south side of Cockshot Point, but the shallow shore and the presence of great prominences and many islands must diminish the power of the waves. Parson Wyke is a small rushy and reedy bay behind which, at a distance of 200 yards, there is a great gravel pit of current-bedded sand and gravel. It is in a slightly rounded ridge running up the fell-side and seems quite unrelated to any present configuration. Ferry Nab is a curiously shaped narrow rock promontory nearly in line with the general strike of the strata. There is a considerable number of erratic boulders, some scratched and some of Borrowdale origin. One especially large one lies on the south side of the promontory. After the reedy and wooded shore of Sourpool Wyke the Glencoin type is continued until the edge is completely embanked where a number of new houses have been built.

A round wooded rocky promontory with a shore of Glencoin type leads on to a succession of jetties and boathouses just north of Storrs Point. Here we have a typical Windermere promontory on the large scale. A projection of solid rock is well planed off and glaciated on the north, with a rocky cliff on the south, where there is a good beach of Bannisdale Slate material resembling the Skiddaw Slate type of pebble, but browner and not so regular in shape. The rocky point projects to the south-west, and there are erratic boulders about and some embankment on the south. There now follows a long stretch of straight shore-line with little variation. Generally speaking it is of Glencoin type, which from time to time becomes of Windermere type where the vegetation becomes very dense. The movement of gravel along the shore from the south, though noticeable, is in marked contrast by its scantiness to what is found on the corresponding shore of Coniston. This must be due to the greater shallowness of the shores and the great density of the vegetation in places along them. Black Beck delta opens down-lake showing windward trend, its circumference divided by the mouth in the proportion of 1 : 2, but the water nearly dwindles out before reaching the lake. There is no small gravel here except what is washed into the roots of the grasses.

Gill Head Beck has a little delta with windward trend and a lot of débris about. Stewardson Nab follows with its flat and slightly curved projection of Glencoin type. Just south-west of Beech Hill Hotel there is a typical drumlin-shaped hill parallel to the lake-shore, grassy and sloping steeply to the water. The road here cuts through live rock and shows a pocket of boulder clay.

Past the Hill of Oaks Sheds the same kind of shore continues, Glencoin and Windermere types alternating. Now a few ribs of rather jagged rock cross the

shore more or less at right angles, but this feature has so far been much less noticeable than on the shores of Coniston in rocks of similar geologic origin.

In the neighbourhood of Blake Holme there is a stretch of picturesque shore with plentiful variety provided by a succession of rocky points alternating with little reedy bays. Just south of the farm there is a genuine precipitous rocky cliff of the Place Fell type—the only example on this east coast of Windermere. A wall here shows gravel movement from the south and a good banked-up beach on its south side. Past Skirtful Crags and Town Head Farm the same kind of shore continues, with rock always very close to the surface. At this farm, in the midst of beautiful park-like scenery, there is a curious feature on the shore. This is a level grassy shelf about 3 feet above the water-level, 10 yards wide, and possibly 100 yards long, backed by an old lake-shore. The assemblage of angular blocks composing the edge of the shelf did not look natural, but the farmer assured me there was nothing artificial there. It might possibly be an old decayed quay belonging to the time when the Langdale slates were brought down Windermere by boat.

At the south end the lake narrows so gradually that one cannot say where Windermere ends and the river Leven begins. On the right-hand side of the road leading past the southern end towards Newby Bridge there is a gravel pit in a grassy hill of gentle slope. The material seems to be an alluvial deposit of rounded stones, and not ordinary drift as one would have guessed from the shape of the hill.

The west side of the lake will also be traced from north to south. Immediately on the west of the mouth of the Brathay is the picturesque rocky and wooded cape of Gale Naze Crag, which rises perpendicularly from the water. It is joined to the mainland by a marshy alluvial piece of land, and must at no distant date have been a rocky island. A deep bay with reeds separates this point from the similar but slightly larger point of Brathay Rocks, which is joined to the mainland by a causeway across the low-lying neck. The land surfaces behind these points of Borrowdale rock look as if this part had been glaciated from the north-west rather than from the north. There are erratic boulders on the west side of the second point.

Brathay Bay is wide and open, with a grassy margin and stony beach in the middle. Low solid rock shows at the head of the bay, forming the edge of land which is glaciated in drumlin-shaped mounds, with the rock close below the surface in all probability. The geological map seems to be not quite correct here. At the south-western point of the bay the boundary is a large glaciated rock with a steep-faced 2-feet drop to the south and a planed north side. The grassy shore of the Glencoin type is littered with travelled boulders. The run of rock edge along the shore here is influenced by the cleavage. After a straight strip, a low glaciated point of rock forms the north end of a well-curved bay with reeds in the west corner and a lot of little isolated rocks standing out in the water. Another similar bay shows the line at the boggy head again determined by the south-west run of the cleavage. The straight west edge of this bay opposite Seamew Crag marks the entrance of the Coniston Limestone. The shore continues the same, but the rock stands up more jaggedly, although quite low. At Brock Point it drops steeply into the water and shows the solvent water action on the limestone. The trees make this promontory nearly impenetrable,

but round the point the rock ceases and we reach a dense Windermere type of shore. A great collection of old reed-stalks is washed up here from the dense reed beds of Sandy and Pull Wykes.

After passing the open low-lying head of the Pull Wyke the densely wooded southern shore is reached, presenting an impassable tangle right down to the shore, where marshy stretches intervene between more solid swellings. The sluggish Blelham Beck runs out amid reeds and rushes on the west side of Bee Holme, a wooded island or peninsula according to the height of the water. At the next open field we are on a shore of Glencoin type, with grass to the edge and great moulded rolling fields behind. The rocky promontories at Wray Castle are very picturesque. Great ribs of rock, glaciated in places, fall steeply to the water, with little beaches of pebbles of Coniston flags and grits in between. The main promontory has three or four ridges of rock in it, all more or less pointing across the lake to Low Wood in accordance with the strike.

Heading round to the rocky point of Red Nab there is a widely open curving bay with a shore showing in many places ribs of rock running obliquely across according to the structure of the rock. South of the point there is a big gravel pit behind an embanked front, and apparently the material is all riverine like that near Ferry Nab. Belle Grange Beck has built out a small boulder-strewn delta. The road lies along the shore, with shrubs and trees on the beach and embankment by the roadside. The mount at Belle Grange is a great corner of live rock with water-worn patches 10 feet above lake-level. There now commences under the slope of Claife Heights a long straight piece of shore, with impenetrable vegetation down to the edge and a steep wooded slope on the fell side, where the contour lines crowd together in parallel rows. As far as one can see it is of the Place Fell type with boulders, no shingle along the shore, and one or two points of solid rock including Slape Scar.

After Bass How the same characteristics continue except that there are pebble beaches and occasional boulders with dense shrubbery at the back, the margin here being of Glencoin formation. A wall here shows gravel movement from the north, probably because wave power from the south is a good deal broken up by the islands and projections. There are now some good beaches with fine timber. Coatlap Point and the south end of Belle Isle approach very close together. The east side of Coatlap Point has been protected by piles, and there is embankment to the north of it. The whole coast-line here is of Glencoin type. No rock is showing on the Ferry Hotel Point, but its line of orientation makes one feel sure that there is a rocky framework underneath. The beautiful bay to the north of it is specially well shut off from wave action.

On the south side of this point there is a high wall embanking the road to the next bay, where there are tall reeds. After Ash Landing comes a stretch of Glencoin type. The bye-road goes over a glaciated rock, and there is the usual moulded grassy field behind, a good beach, and some trees and boulders. Jemmy Crag has a steep southern side and a little beach. A stretch of Windermere type follows down to Sandy Nab. About this point the fells recede on both sides of the lake, and in this middle portion so far as elevation and scenery go we have the tamest part of the whole lake. From High Cunsey boat-house to Cunsey Beck Foot there is a long curving bay with a wide grassy field behind and a high grassy moulded boulder clay bank 10 feet above the shore, which

Wide stony beach, Bassenthwaite

Glacio-fluvial shelf, Ennerdale

Looking up Ennerdale from drift–covered shore at foot

White boulders near exit of Hawes water

either marks an old lake-level or the extent to which wave action has cut back the edge. There is a good storm beach covered with shrubs towards Cunsey Beck, the boggy and rushy mouth of which opens up-lake, possibly driven in that direction by Ling Holme and the higher drift ground to the south.

Rawlinson Nab is a most picturesque promontory formed of several ribs of rock running in the usual south-west and north-east direction. It is an excellent example of the Windermere cape. A few boulders lie on the north side as if caught by the projecting rock. The south side of this wooded point is much more abrupt, and here there are two little beaches and some semmel. After Rawlinson Nab there is another grassy field with irregular moulded drift surface with a steepish bank some yards back from the shore, as in the ground north of the point. Hammer Hole, a miry bay, leads on to a wooded Glencoin type of shore backed by dense shrubbery. Lazy Bay seems to be formed between two south-westerly directed ridges of boulder clay, probably with a rocky core. Now a great sloping slab of glaciated rock dropping at a steep angle straight into the water makes the shore impassable. The next projection has erratic boulders on the north side, but it is extremely rough, with great blocks of fallen rock, and is dense with shrubs.

The shore here is of the Place Fell type, and is the roughest bit on Windermere for rock work. Then an impenetrable bit with shrubs on rough rocks leads round to the causeway to Grubbin's Point, which is a low rocky projection with the usual orientation. After another low rocky point a turn to the west brings one to a strip of shore where a gravel beach covers a spongy substratum of clay. A gravel pit here seemed to be mainly composed of riverine material. Opposite Silver Holme there is a small delta with windward trend to the south. Long Tongue is a boulder clay promontory with one boulder protecting the point. The next point is a great sloping slab of glaciated rock like that previously mentioned. It has the usual steep face on the south side. A rocky shore leading past a reedy recess where the apex of the bay is a rough right angle brings one over a good storm beach to the point opposite Costrell's Rocks.

Some little distance north of Lakeside a deeply cut circular bay, partly filled with reeds, lies at the foot of a rough grass field. From the rocky point south of this a straight run of shore with a beach leads to Lakeside Hotel, where there is a good width of gravel. South of the station there is a curious circular projection which greatly narrows the outlet of the lake. All round the east side of this plateau there is a good beach 8 yards wide shaded by scattered trees.

Loweswater

On commencing an examination of the shores of this little lake at Watergate Farm, the most southerly point, it is seen that on the Skiddaw Slate pebble beach there are many rounded boulders of granophyre. Probably this arrived by ice-action down Mosedale from the south. The whole east end of the lake to the mouth at the most easterly point is the edge of a great gently sloping delta brought down by High Nook and White Nook Becks.

North-westwards along the shore from the farm there is an evenly steep fellside with trees and vegetation to the edge. Then there follows a great deltaic bulge occupying nearly half of the whole south-west shore, which has been built up by Holme Beck. Its gently sloping surface is covered with trees. The

outlet, with a growing point, is right in the middle, and at each re-entrant angle there are artificial runners cut for drainage. There are older higher delta banks at these corners, and at one time there has been a great outlet at the north-west corner. There also seems to be a distinct inner lip on the shore at this north-west end, about 20 feet above the present level. There is a tiny but beautifully rounded delta just north-west of this big delta, and it has its outlet on the east side. A similar dead delta lies a few yards farther on. After a rounded grass-covered slope of drift a third alluvial stretch is reached, the boggy head of the lake drained by one main and two or three subsidiary runners. Owing to the direction of the drainage of this lake inland towards Crummock-water instead of out to the north-west, only a small proportion of its supply of water enters at the head.

On the north-east side a fine little semicircular delta-like projection is soon reached. It has no runner now, and its profile would lead one to take it for a delta were it not for the fact that there are big boulders on the west side and that there is a stretch of shore of undoubted Glencoin type towards the south-east. It is conceivable that it is a dead delta over which a slight later re-advance of the ice has passed lightly. A straight piece of shore follows, with moderate-sized Skiddaw Slate stones, some big erratic boulders, trees, and later some granophyre boulders. From here it is well seen, on looking down the lake, what a great amount of alluvial material has been brought down near the outlet of the lake and how it has driven this outlet right over to the north-east, giving the lake its sharply pointed exit. Just before the outlet there is another delta delivering to the west, and there are reeds near the mouth of the lake.

It will be noticed what a great proportion of the margin of this little lake is formed of deltaic or alluvial land.

Derwentwater

A few additional remarks may be made on this lake as the result of visits subsequent to the first part of this paper.

The point at the north corner of Scarfeclose Bay, with its 12-feet cliff of boulder clay, is very vulnerable to wave action, and from a careful inspection of the great boulders around its base, it is fair to infer that at least some of these have been placed where they are by early farmers of the valley to protect the scanty valuable land behind. Probably there is no tradition of such action, but there would be movable boulders to be cleared from the land behind when farming became a reality, and the most natural place to clear them would be on to the beach. A rough embankment of great boulders on the south inner corner of Measand delta on Haweswater makes one feel certain that they have been artificially arranged. Any particularly valuable piece of land like a delta or a gently sloping bank of boulder clay, if exposed to violent wave action, would be protected sometimes by boulders cleared off the bank, sometimes by a margin of trees planted round the delta front.

The east side of Scarfeclose Bay has a big storm beach covered with vegetation. This runs south into a bank of boulder clay, and that again is continued in a 7-feet steep bank of glacio-fluvial current-bedded gravel. There is a good storm beach round most of the Cat Gill delta. At several places between the south-east corner of the lake and Grange there are exposures on the left side

of the road of glacio-fluvial material—a yellowish mass mainly of rounded stones without obvious bedding and at about 8 feet above the level of the alluvial land.

The shores of Manesty and Brandlehow Parks show the influence of cleavage on the margin. In the former, where the cleavage runs north-east and south-west, there is a succession of rocky promontories pointing north-east. In the latter, where the cleavage is nearly north and south, there is an almost straight piece of shore-line running in the same direction. The main features of Brandlehow Park shore are a straight shore-line, as the cleavage enabled rock to be planed off smoothly by ice action; a small capping of boulder clay, giving a line of boulders at water-level; little beaches of Skiddaw Slate pebbles; a lack of streams; and everywhere a good but not dense covering of trees.

The same Glencoin type continues past Otterfield Bay, where there is a big bed of reeds; Kitchen Bay, a circular opening between two points of rock with a good beach on the south side and a low marshy head; and Derwent Bay, which merits a word to itself. This is a noble bay between two points of rock. The north side, which is clothed with beautiful pines, is embanked with a Cyclopean wall of erratic boulders. I suspect that around these three bays the direction of cleavage has again altered, although this point was not verified on the spot.

Copperheap Bay has fine rocks around a great part of it, with no beach except at the north-west corner, where slabs of Skiddaw Slate occur, possibly connected with mining operations in the past. There follows a spell of rocky shore without any beach at all and trees to the edge. Here there is a 10-yards-wide intrusion of dolerite between the ends of the dyke marked on the geological map. This rocky shore on the north-west of Derwentwater has a steep cliff about 10 feet high, no beach, some erratic boulders at the edge, and trees right down and even over the water. But this type does not continue for any great length at a time.

The larger islands in this lake have been described as drumlins, but some of the smaller ones are solid rock. Otter Island at the south-west corner and Lingholm Islands, where we are now, are of rock. In 6 yards of this main Lingholm island the cleavage turns through 30°.

Galemire Bay has a rim of boggy alluvial land, and the inner part has a plentiful supply of reeds rising from a clay bottom. At Fawe Park there is a good sloping gravel beach with grass, trees, and bushes. To the south of Nichol End there is a rocky cliff and no beach.

The north end of Derwentwater has possibly the greatest collection of reed-beds in the Lake District. They commence soon after Nichol End and occur at intervals right round up to the shore of Town Cass, where there is a huge bed of dense growth. At the north-west corner there is low-lying alluvial land which runs round with little intermission to the low-lying area below Crow Park. There is however one small break at the north-east corner, where a very low piece of drumlin merges in its alluvial surroundings.

Along the alluvial land there is usually a small 1-foot cliff of clay with irregular bites taken out by the undermining action of the water. After the great bed of reeds mentioned above we reach Isthmus wood, which must have been a drumlin island at no very distant geological time.

Bassenthwaite

Between Derwent mouth and Embleton road the shore is very flat and paved with blackened rounded Skiddaw Slate stones with grass and reeds between, and backed by willows and other shrubs. In the corner by Dubwath Beck the shore is very shelving, and there is a great growth of reeds backed by low mounds of glacial material covered with grass or scattered trees. South of the mouth there is an old storm beach covered with grass and bushes and well above usual water-level. South of the station and on the left of the road going south there is a big broad bank of glacial deposit 8 or 10 feet high banking in the marshy Dubwath valley. There is solid rock falling precipitously to the water near the landing stage, followed by an embankment, and then a beautiful delta-like bulge of gentle curvature and a 15-yards-wide beach showing considerable wave action on the exposed roots of the alder bushes. Another rounded projection with boulders is evidently of the Glencoin type. It has a very wide flat stony beach. This is the predominant feature of this side of Bassenthwaite. The shore has the appearance of being roughly paved with blackened dry slimy stones of rounded Skiddaw Slate.

Proceeding in the same direction, the shore is in places very flat. At the time of my visit there was a great stretch, 20 yards wide, scattered with bigger stones lying dispersed as if left exposed by the erosion of the drift. Behind this the live rock showed fine water rounding by wave action. In these two particulars the shore forms a great contrast with the average beach in Borrowdale areas. Grass develops in places, so that the least fall of water-level would transform this beach into a wide grassy shelf. Continuing in this southerly direction this Glencoin type shows boulders spaced out rather than aligned, and from time to time the shore feels quite spongy beneath its covering of stones. The beach becomes so wide in places that the shore-line is marked as indefinite on the 6-inch map. There are great spits and detached areas of gravel. In one place a width of 30 yards was noticed. There is a great dearth of streams on this shore, and the water must percolate away below the surface.

Where the railway follows the margin more continuously the beach narrows, and the signs of the Glencoin type disappear. Live rock occurs, with a flat narrow beach which must disappear entirely in high waters. Beautiful bedding planes of different tints appear in the rock on the shore. There is much embankment.

The Beck Wythop is right on the very south-west edge of its great delta. There is a fine wide beach here rising 8 feet above water-level. Then live rock appears again with a narrow rocky shore. At this point the road cuts right through a considerable cliff, and there is a big perpendicular drop to the water. More embankment leads on to a continuous stretch of Glencoin type right up to the alluvial land at the head of the lake. There are three considerable promontories of which the first two—Hursthole Point and Blackstock Point—are of a remarkable equilateral shape and the third of a roughly semicircular shape. Both the named points have trees and are grassy and the second one has a good storm beach consolidated by shrubs and trees. South-east of Blackstock Point the shore is again wide, flat, and spongy like the stretch described above. One can see the grassed-over higher and older part of the beach with boulders lying about. Along the whole of this left shore of Bassenthwaite there

is a lack of evidence of movement of gravel along shore, and this fact is reflected in the curiously symmetrical sides of Hursthole and Blackstock points, which differ materially in shape from such boulder-clay projections as Thwaitehill Neb on Ullswater or Boulderstone Neb on Haweswater.

Off the low-lying head of the lake there are reed-beds as well as islands and irregular peninsulas of alluvial matter. On the left-hand side of the Derwent mouth there is a specially noticeable growth of such deposits. The right-hand shore of the lake begins at once with a Glencoin shore, and in the second field there is an old lake-shore 10 feet above the present level and which is again apparent farther on. The boulders lying about the shore here have been used for balks and walls. A dense wood follows where the Glencoin type is continued. The boulders have probably been aligned artificially.

In the angle of Church Bay, just before Bowness promontory, there is a group of great boulders; one of the largest is a flow breccia. This large promontory is an intrusion of dolerite with a 10 or 12 feet cliff around the steeper part at the main point. The beaches are of angular fragments of this rock with some scattered erratic boulders. The whole point is covered with trees, and at its north-east angle it drops gradually down to the alluvial land which runs partly behind it and also behind Scarness.

Ennerdale

The rounded end of the lake by the Anglers' Inn has a low-lying shore with a long stretch of low-walled embankment to protect this boulder-clay coast. Just beyond the small marginal strip of woodland lying to the west of the inn there is a pebble beach a yard or two wide as if this was a resting-place for small material locally. The beach ceases towards the inn, although there is a small beach there also, and it ceases westwards at the lower flat stretch near the Ehen mouth. Towards this mouth rough boulders have been thrown down as a protection for this very vulnerable low coast. A projection of turf and boulders here shows shore movement from the north. The stones and fragments of rock here are interesting. They seem to include limestone, sandstone, granophyre and Skiddaw Slate, of which some was metamorphosed.

Directly after the Ehen crossing there is a large dry delta from the gully of Ben Gill, followed by a curious red-earth bank parallel to the edge, and apparently of boulder clay. After this the rather straight shore, broken by small irregularities, which runs to Anglers' Crag, is a continuous dry delta slope covered with vegetation and intermediate in character between the old scree slopes of Wastwater and the tamer dry delta slopes of Mellbreak on Crummockwater. Halfway along, at a small point, there is a fair beach, mainly composed of metamorphosed Skiddaw Slate. There is a beautiful little circular beach before Anglers' Crag, where the main wave action in cutting out the beach from the fellside comes from the west. Above the beach proper there is a stony talus at the foot of the dry delta slope. There is distinct shore movement up-lake here.

At Anglers' Crag the shore-line is of the Place Fell type. The crags are very fine and quite like Borrowdale rocks in their boldness. The Skiddaw Slate has been hardened by the proximity of the intrusive granophyre. All along the shore so far there has been an absence of the small elongated disc-shaped pebble

that one gets on ordinary Skiddaw Slate shores. Some striations occur on the cliff face.

Directly south-east of Anglers' Crag the rocks on the fellside change and a long piece of straight shore-line occurs, cut out of the edge of a continuous granophyre dry delta slope. There is no pebble beach but a block-strewn shore, where the boulder fellside stands 5–10 feet above water. This kind of margin, covered with sub-rounded blocks of granophyre, continues for a long way, till nearly opposite the mouth of Smithy Beck. Up to Anglers' Crag the fragments of rock are sharp and angular. After the point they become sub-rounded, the fell recedes, and the granophyre blocks weather grey, with the pink just showing through.

The fellside becomes gradually more and more closely covered with trees and bushes. Red Beck has built up a considerable débris delta slope on the fellside, but no appreciable projection into the lake. It has covered the slope with a plaster of boulders, as it had not power to carry such considerable blocks to the water edge where the gradient was less. The same block-strewn shore continues, except that the fell is more densely wooded and the blocks become slightly more angular. Opposite Smithy Beck a new feature comes into view. There is a sort of flat shelf, 30 yards wide, with an approach to a pebble beach. No clear section can be found, and it would pass for ordinary drift were it not for the fact that in one place at least it looks exactly like the glacio-fluvial deposits which occur so much on the right side of the lake. This shelf is followed by two more stretches of the same nature. Just in the angle of the lake there is a beautiful little beach showing much shore movement from the west. Here a considerable ridge runs up the fellside, possibly formed by two adjacent streams re-excavating their own deposits.

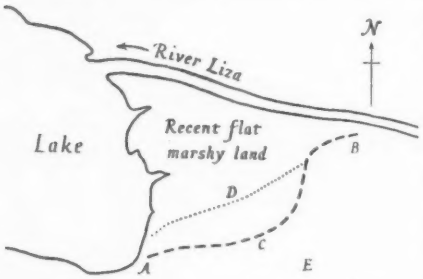


Fig. 3. Head of Ennerdale. ACB = old 20-foot alluvial platform. D = intermediate line

The head of the lake is extremely interesting, and it probably raises more problems than can be solved at once. The less remarkable features consist of an extensive beach, with a good storm-beach 3 feet higher than the boggy, recent land behind it. The beach itself rises steeply to a height of $3\frac{1}{2}$ feet, with pink granophyre and blue Borrowdale pebbles. Near the river mouth there are flat spits and islands of gravel. The extraordinary features are as follows: Along the south-westerly side of the recent alluvium there is a higher shelf of older alluvium standing 20 feet high, having a flat delta-like top, and apparently formed of glacio-fluvial material, with rolled pebbles and quite a stiff matrix. Between this and the river mouth there is an intermediate line or margin, so that there are really three shore-lines. The beach has a good slope halfway across the head, and then it drops to water-level and the land is an absolute marsh.

The land at E on the top of the shelf (see Fig. 3) is perhaps 20 feet higher

than the land farther up the valley, and the huge delta from Woundell Beck to the south-east falls to the river Liza with a steady slope dropping apparently lower than this high platform. The top of the platform is slightly undulating. It will be remembered that Dr. Mill found evidence, in the subaqueous contours, of an old river mouth to the south of the present one, and this high shelf may be contemporaneous with that. It is fairly evident that the Great Woundell Delta has driven the Liza over to the north and has saved this older alluvium from destruction.

On the right-hand side of the Liza, the same high-level shelf appears again. It runs along the fell foot at a height of 10 or 12 feet above the road. Just beyond the river mouth the granophyre rock comes down to the shore in a glaciated shoulder. Smithy Beck and Dry Beck look as if they had been driven apart by a huge fan of débris descending from the two gullies. Former examination of this right side revealed the great extent of the glacio-fluvial shelf along a part of this shore. What is the meaning of these deposits which have now been found at the east end of the left shore, at the head of the lake, and along a great part of the right shore? Are they simply the undenuded shores of an older level of the lake? This is, of course, the easiest solution and one quite in accordance with the discovery by Mr. E. E. L. Dixon, A.R.C.SC., B.SC., that Ennerdale was dammed up by moraine from the Irish Sea ice. But a great deal of the material of these deposits seems more rolled and rounded than is characteristic of a lake-shore formation. One cannot help being haunted by a suspicion that they might be the undestroyed remnants of something older.

A great delta has been built up by Gill Beck, and the stream through it is well to the western side. This is the windward side for this part of the shore, according to the testimony of a wall just on the west side of the delta. Another little delta here also shows the windward trend.

At the north end of the lake and just before the Anglers' Inn there is a good layer of peat right down to the shore, with a small pebble beach at the foot of a little 2-feet cliff of peat. Probably this peat has been produced on a substratum of boulder clay.

Haweswater

After the lecture in March 1928 on the first part of this paper Dr. Mill called attention to the white boulders on the east side of Haweswater, making use of the illustration that they looked as if they had been whitewashed like the edge of a railway platform.

I made special visits to the lake to look into this question, but on two or three occasions I was unlucky. The phenomenon was absolutely unnoticeable then, although I well knew that at other times it was very much in evidence. On one of those visits I found at the exit of the lake a great deal of a certain white clay. This material lay below water-level in an alluvial flat by the lake-side, and it was exposed in some cuttings where the Manchester engineers are at work. The clay contained a plentiful supply of boulders, some of which had bleached surfaces, while others had fresh ones. Coming on this white clay with bleached boulders in it at a time when I was trying to explain the rim of white boulders by the lake, I thought the two things might have some connection. I sent specimens of the clay and of the commonest included type of boulder to Jermyn

Street. I am indebted to Dr. Bernard Smith, who replied, telling me that he himself had found the same clay and had submitted his specimen and mine to the Petrographer, Dr. H. H. Thomas, who found that: "(1) The clay consists chiefly of quartz, muscovite and kaolin in an extremely fine state of sub-division, with a fair proportion of siliceous micro-organisms, *e.g.* diatoms and spicules of freshwater sponges. The proportion of organic remains is difficult to judge, but it does not appear to be greater than 10 per cent. (2) The clay is most likely derived from the local boulder-clay and in the main from the Borrowdale Volcanic Series. (3) The rock specimen appears to be dolerite. (4) Bleaching is due to solutions percolating through the clay or existing in the water in which the clay was deposited. These might be humic, siliceous or alkaline; but the presence of diatoms is against alkalinity."

Another visit after a spell of quiet frosty weather was more fortunate, and I saw the water edge ringed by a clear white line of boulders. It then became perfectly evident that the presence or absence of the white line depended on the weather and on the state of humidity of the air and the boulders. I thought it was due to the presence of some lichen which became white when very dry. After detaching several specimens of rock with the white incrustation on them, I sent some to the Director at Kew Gardens, telling him the problem and asking if he would tell me what the growth was. He replied that the white incrustation was due to a thick coating of diatoms. "In a paper in the *Naturalist* for 1909, Haweswater is reported to have a plankton consisting mostly of diatoms which reach great development at certain seasons of the year. These are washed up by the waves and become attached to blue, green and other algae which often cover the rocks by the side of the lake. The skeletons of the diatoms would appear white in the mass."

Little need be added. A very full and learned account of the Phyto-plankton of the English Lake District by William West, F.L.S., and G. S. West, M.A., D.SC., F.L.S., will be found in the *Naturalist* for March, April, May, July, August, and September of 1909.

It will be evident now that the line of white stones is not any result of the white clay nor of any bleaching that it may be capable of effecting. Both phenomena are connected with the microscopic life of the lake water, the white line being entirely dependent on it and the white clay dependent on it to some extent for its formation. The white line of boulders will not be seen in rainy or windy weather, for then the algae coated with diatoms will appear dull greenish-grey. It will be most evident after a considerable spell of dry, quiet weather, either fine, frosty winter weather or sunny summer weather. At the time of my last visit it was curious to notice that the boulders were not white within about 5 inches of the water-level, nor were they white higher than about 15 inches above the water-level. The lake surface was completely frozen in the neighbourhood of these boulders, and yet sufficient moisture was obtained from the ice surface to prevent the white appearance close to the ice. This makes it clear that the best chance for the development of this white line will occur when the lake is low and when the weather conditions are those mentioned above.

The bleached boulders in the white clay had not been bleached by their presence in the clay. Some surfaces were quite fresh. I think the boulders had been bleached chemically elsewhere and had been moved by ice action to their

present position in the clay. The white clay was formed under water, and yet it is stuck full of boulders. The level wide beach by the east side of the lake is littered with boulders. My own feeling is that these places may have been passed over lightly by a re-advance of the ice, but this is only a suspicion unsupported by adequate proof.

The Rate of Growth of Deltas.

This point also arose at the lecture in 1928 through a comment of Dr. Mill's upon the erosion at the head of Windermere. Dr. Mill called attention to the rate of growth of the alluvial land in that place, and also to the great signs of erosion due to wave power. As the latter point had not been at all evident when I visited the lake, I made several inquiries which cleared up the difficulty and led to a lot of interesting information which is doubtless common knowledge to the people living on the spot, but which may be of interest to those who are less fortunate.

In the first place I appealed to Brigadier E. M. Jack, the Director-General of the Ordnance Survey, who most kindly sent me tracings of the oldest and newest authenticated positions of the water edge in certain selected places. These maps on a scale of 1 : 2500, with the old line in black and the new line in red, are most interesting, but it is impossible to reproduce all of them here. If two are shown on a reduced scale, however (see Figs. 4 and 5), the other results can be summarized in words.

The disturbing element in this subject is the hand of man. None of these deltas can be looked upon as quite natural. The least little piece of level ground in the dales must have been most valuable, and at an early date the primitive farmers would protect it as well as they were able. Still much more disturbing has been the effect produced by miners. Mining operations have greatly increased the growth of the delta at Glenridding or rather of the modern delta; for behind this modern delta there is a huge semicircular delta which has not altered for untold ages. Again, the same factor has produced great development in the deltaic land near Coniston town.

Here I should like to mention the useful information about Coniston kindly sent to me by Major R. E. Porter of Rydal, and also the great kindness of Mr. W. G. Collingwood, the President of the Cumberland and Westmorland Archaeological Society, who has given me much information of great interest about Coniston and also about the head of Windermere. Lack of space again makes it necessary to compress unduly.

Six sites were chosen: three where the hand of man was particularly evident, and three where his influence was less apparent; but all, or all but one, where growth might have been expected to be appreciable. The first three, which included the two mining areas, were: the Glenridding delta on Ullswater, the two deltas at Coniston, and the head of Windermere. The three which were less affected by man include the Aira Beck delta on Ullswater, the Trout Beck delta on Windermere, and the foot of Derwentwater, which of course is in a different category from the other five places.

The modern Glenridding delta has undoubtedly had its shape influenced by the fact that the Greenside Mining Company has periodically for many years now cleared the beck out. This cleaning process has an effect on the position of

the mouth of the beck. The beck brings down whitish, muddy-coloured water, and the landowners at the mouth do not like it any nearer their land than can be helped. This possibly may have resulted in a greater growth of the delta nearly

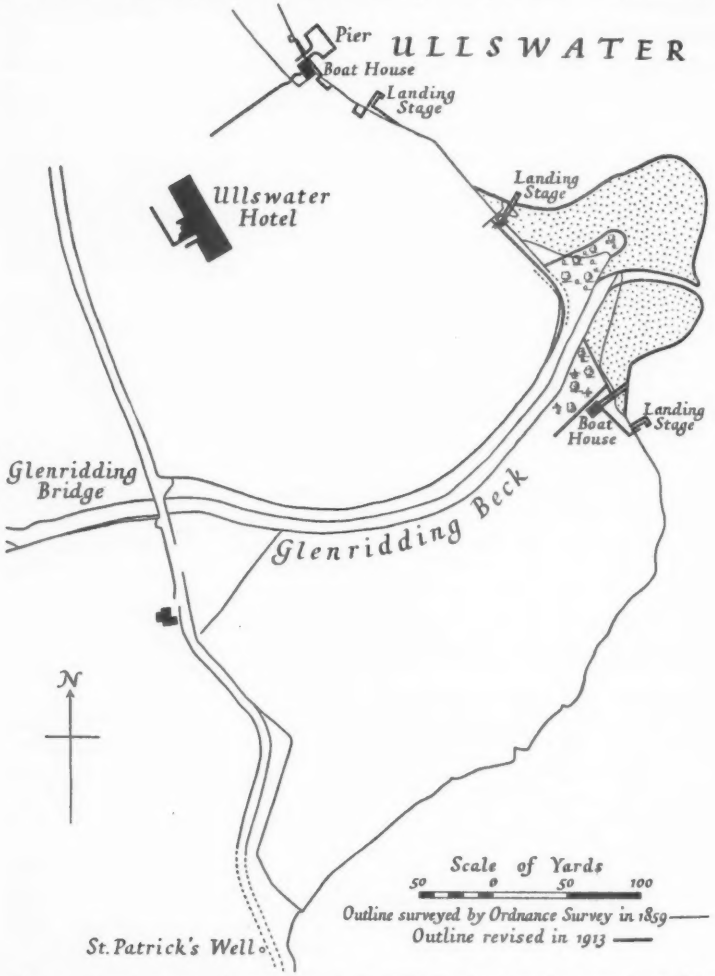


Fig. 4. Sketch-map reduced from O.S. tracing, showing the growth of Glenridding delta

at right angles to the shore-line than would otherwise have occurred. Along this line of greatest growth, *i.e.* in the direction of the last stretch of the beck itself, the Ordnance Survey outlines show an addition of 83·6 yards between 1859 and 1913. This is at the rate of 1·54 yards per year. The rapid

growth of this delta and the muddy water of the beck are an eyesore to the neighbourhood.

The deltas of Church Beck and Yewdale Beck at Coniston have combined to form a great stretch of shingle. As early as 1620 gravel from the Church Beck, on account of a new stamp for mining purposes, was invading the town fields and the beck had to be straightened out. The Ordnance Survey outlines of 1888 and 1912 show that the actual place of exit and the shape near the exit have altered, but that no great change has taken place in the advance of the front into

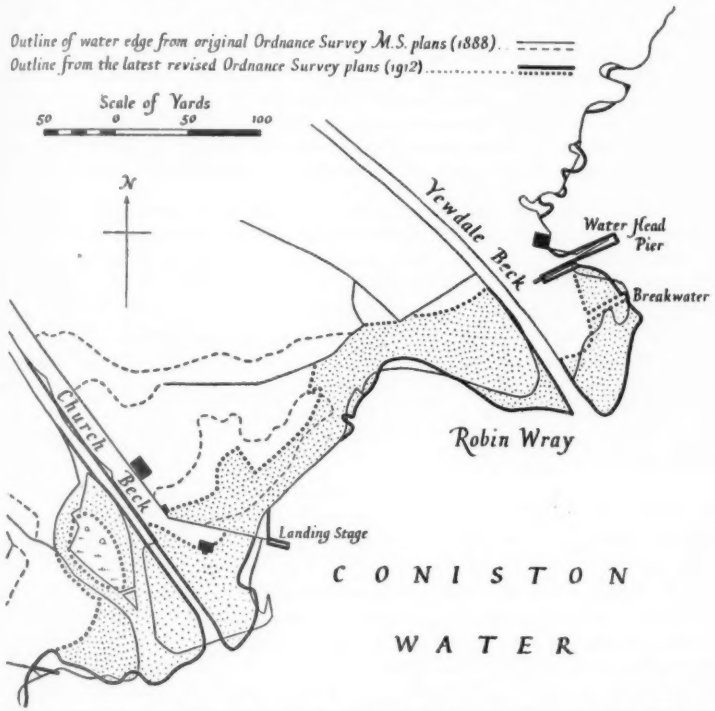


Fig. 5. Sketch-map reduced from O.S. tracing, showing alterations in Church Beck and Yewdale Beck deltas

the water. But a great advance of the front at Yewdale Beck mouth is shown, and this may be largely due to material from Church Beck being carried along shore to Yewdale Beck. The advance in the latter place in these twenty-four years had been 34 yards, a rate of 1·41 yards per year.

The case of the head of Windermere is the most interesting historically. Here the Ordnance Survey outlines in the years 1858–59 and 1911–12 show only slight fluctuation. On the whole a slight increase of land is shown near the houses and jetties and a slight loss of land near the mouth of the Brathay, but neither change worth mentioning. But this piece of land has been influenced

by man ever since the time when the Romans built their Ambleside fort within a short distance of the water edge. Mr. Collingwood said:

> "The south side of the fort, outside the rampart, has been protected by a sloping bank built in Roman times, and containing potsherds all through its thickness. Therefore in high water and high winds the lake came up to the fort. In low water there must have been marshy ground—as at the head of Coniston Water, where the present road which forms the lake-shore was built about 1800 or a little earlier, and before that the lake ended indeterminately in a marsh. The National Trust made at the head of Windermere an artificial foreshore about fifteen years ago to prevent erosion, but before that the water often came up to the fort. The first Roman fort (Agricola's, about A.D. 79) must have been found liable to flooding, because the Hadrianic fort (about A.D. 120) was raised by a mass of clay and gravel, varying in different parts from about 6 to 3 feet thick, spread over the old site. But the old site, in Agricola's time was already above normal water-level: indeed, I believe there was nothing found to suggest that the lake-level had altered during historic times."

So much for the three preceding places which are far from natural. The other three can be disposed of much more quickly. The land near the foot of Derwentwater has altered between the years 1862 and 1923 in the following way. On the right-hand side of the Derwent the outline is practically the same, and where there is any change it is in the direction of slight erosion. On the left-hand side a very considerable alteration has taken place, and a great square piece of land has been rescued from the water in such a way as to bring the two shores at the exit into line with each other. Aira Beck delta on Ullswater between the years 1861–2 and 1898 showed absolutely no alteration at all except that at the sharp promontory called Aira Point, which is not at the beck mouth, there was a collection of shingle at the later date.

Trout Beck delta on Windermere is interesting. It will be remembered that Dr. Mill called attention to the wave action in the Calgarth lands on the right lobe of this delta. The Ordnance Survey outlines for 1858 and 1911 make it clear that slight alterations have occurred along nearly the whole front, and nearly always in the direction of slight erosion. The actual mouth itself has completely altered its shape and slightly altered its position. The evidence of these big deltas which are free from mining influences seems very striking. One would have expected some slight advance of the frontage towards the water, but instead of that the movement is in the other direction. It reinforces other evidence that, until a late stage in the process, the filling up of these lakes takes place from the bottom more than from the sides.

In closing I again wish to express my thanks to the private owners who have invariably been kind in allowing me to visit their grounds.

THE MOUNTAINS ABOUT TATSIENLU

IN the charming map which illustrates the 'Trail of the Giant Panda' the Messrs. Roosevelt have shown south-west of Tatsienlu a Mount Koonka with the attractive height of 30,000? We naturally ask whether there is the more virtue in the 30 or the mark of interrogation, for the accompanying photograph shows a hillside with little evidence of permanent snow, and the text is not quite so bold as the map; the authors say:

Early one morning we got our first glimpse of mysterious Mount Koonka, rising high in white majesty. At Yungning, Rock had told us of his ambition to put in three or four months studying its flora, and once more we regretted the lack of time that made it impossible for us to make a reconnaissance of its fauna. The altitude of this mighty peak is unknown, but there are those who claim that it rises more than thirty thousand feet and is the highest in the world. A geologist from Chengtu made a special expedition to establish Koonka's height, but after he had taken his observations he refused for some entirely unaccountable reason to divulge them. When any one questioned him he merely imitated the beaver and "looked unaccountably shy" (*Trailing the Giant Panda* (1929), p. 129).

As we reflected on this matter we received a visit from Mr. Herbert Stevens, who had been a member of the Kelley-Roosevelts Expedition, but had been detached on a separate collecting trip, and passed through Tatsienlu some days behind them. He had been favoured with exceptionally clear weather, and brought sketches of several remarkable snow-peaks seen from the passes in the neighbourhood: peaks evidently rising several thousand feet above their neighbours, and clothed for at least that height with permanent snow and ice. But Mr. Stevens had made no surveys, and could throw no light on the question of their absolute height.

Remembering then that Mr. Kingdon Ward had once worked around Tatsienlu, we asked his opinion on the probability that there might be very high peaks in that country, and have his permission to print the following reply:

I have now been a little into the question of the snow mountains round Tatsienlu. One must admit at the outset that as there are no certain facts to go on, we have to argue from analogy, and draw conclusions from circumstantial evidence; but I think you will agree that there is not much hope of finding a second Mount Everest here. The line of argument I take is this. Several travellers have commented on the great height of the peaks round Tatsienlu; but one must remember that it is the suddenness of the appearance of great snow ranges that is the most remarkable feature. One is immediately prone to exaggerate their height (coming from the Szechwan plain). Few if any peaks south of Tatsienlu are fixed. Davies shows one or two, height under 17,500 feet. Legendre shows one or two, height 6000 metres. Not much help there.

Now the snow line may be taken as 17,000 feet, possibly 17,500. This agrees with my experience round Muli; Wilson says definitely, "the snow line cannot be less than 17,500 feet"; on the other hand Johnstone says he crossed many passes from 12,000 to 17,500 feet high, "some of them above the line of perpetual snow." Put it at 17,500. If the average height of the peaks were 20,000 feet, the view of snow peaks from any vantage point would be stupendous; and although Gill is almost lyrical about the view, he is not stunned into any wild calculation. He concentrates chiefly on the view to the north of Tatsienlu, and says quite soberly

that the peak called Ja-ra (Ja-ri?) rises 4000–5000 feet above its neighbours; he saw it from 30 miles distant, at a height of 14,454 feet himself. Now any mountaineer knows that a peak 5000 feet above its neighbours is, at the right distance and the right angle, a pretty conspicuous object. Namcha Barwa rises perhaps 4000 feet above the surrounding peaks, as seen from the north; and it is like a church steeple surrounded by cottage roofs. Ka-kar-po (Kagurpu) is perhaps 2000 feet higher than its neighbours, and Gregory guessed its height at 24,000 feet, though I believe I hazarded 22,000 feet. But suppose we do allow 20,000 feet for the Tatsienlu peaks, which is very generous, then a peak 25,000 feet high would be a stupendous sight. There would be over 7000 feet of snow, and the glaciers would descend to 15,000–16,000 feet, if not much lower; at least they might reasonably be expected to descend 2000 feet below the snow line.

Therefore it seems to me quite impossible that there can be anything of the order of Mount Everest near Tatsienlu. Had there been, every traveller must have raved about it. Pratt, who spent some time in the neighbourhood, says little about the snows. Cooper says nothing. Wilson says little. Davies says little, and so on. Hence I maintain that it is extremely unlikely Minya Gongka exceeds 25,000 feet at the outside. I hope I may be wrong.

Meanwhile we had been visited by another traveller from the same country, Mr. G. S. Stavely Gordon, who discussed the problem and afterwards wrote thus:

In October last year I travelled down the caravan route from Yachow to Ningyuan via Ch'ing Ch'i, Fulin, Yeuhsi and Luku. Just north of Ch'ing Ch'i we crossed the Ta Hsiang Ling (Great Elephant Pass) at an elevation of approximately 10,000 ft. (Aneroid height as Boiling Point instrument failed). The weather on top of the pass was somewhat overcast and visibility not of the best. The general elevation of the mountains south of Tachienlu and west of my route appeared to be about 5000 feet higher than the Ta Hsiang Ling—*i.e.* about 15,000 to 16,000 feet, and these mountains were visible all over an arc extending from about N.W. to S.W. One particular mountain S.W. of the pass seemed to rise isolated from out of the general mass of 15,000-ft. mountains and to stand up several (say 4000 or 5000 ft.) thousand feet above them, but the top was not visible. I reckon this peak to have been about where Tzumei is indicated on the Survey of India 1/Million sheet (Kiatingfu), *i.e.* about 45 to 50 miles S.W. of the Ta Hsiang Ling. An attempt to get another sight of this peak from the Hsiao Hsiang Ling (Small Elephant Pass) situated about half-way between Yeuhsi and Luku (elevation about 9000 feet) failed owing to the pass being covered with mist and sleet. Photographs taken from the Ta Hsiang Ling do not show any distant snow mountains, owing to the poorness of the visibility. The above is all I can give as first-hand information. I was informed both by Mr. L. A. Lovegren of the American Baptist Mission at Kiating (and a keen geographer and traveller) and by Dr. R. L. Crook of the American Baptist Mission at Yachow that during the summer of 1928 some American members of the staff of Cheng Tu University spent a considerable time (say four to six weeks) in triangulating and getting sights of Tzumei Shan (which is considered to be the highest mountain in the district), and that the result seemed to show that Tzumei was certainly over 28,000 feet—probably over 29,000 feet. The results of this survey were not however being published for the present, as it was intended to make further observations; and for one thing the final elevation depended a good deal on the true elevation of Cheng Tu University standard barometer, to which the triangulation of Tzumei had been tied.

Here we had fuller reference to what was probably the same attempt at survey, for it had the same feature that the result was not published, but it referred to a different mountain. Examination of the not very numerous maps of the region then revealed the curious fact that our knowledge seemed to have been going backwards during the last fifty years. The earlier maps showed names and heights that had been gradually dropped, and this demanded examination. We have therefore put together the following notes, as bearing upon a problem that demands solution:

In Volume II of 'The River of Golden Sand' Captain Gill describes two peaks Ja-ra and Ruh-ching, and on the accompanying route-map, opposite p. 117, marks Kung-Ka, which is not in the index and which we do not find in the text. He says:

[Starting south from Tatsienlu in August 1877] . . . right in front a fine snow-field on Mount Ru-ching glittered in the bright sun; and to the south-east another mountain every now and then showed in patches of snow, as the clouds came and went from its lofty summit (*River of Golden Sand* (1880), vol. ii, p. 119).

[Turning west to the Cheh-toh-shan pass (Jeddo of Cooper)] The morning was beautifully fine: there was a delicious feeling in the air, and looking back down the valley, there was a glorious view of a snowy mountain, whose edges were just lit up by the rising sun, and whose glittering pinnacles of ice and snow shone like points of brilliant light (p. 121).

[Continuing westward on the road to Batang, after a descent:]
The first crest we reached is called in Tibetan Ka-ji-La, or in Chinese Ko-Erh-Shi-Shan, 14,454 feet above the sea. The view when we reached the summit was superb. Looking back in the direction from which we had come, range after range of mountains lay at our feet, culminating at last in the most magnificent snowy heights, one of which raised its head about 4000 or 5000 feet above its neighbours. It was a magnificent peak, and at this distance looked almost perpendicular. Its name in Tibetan is Ja-ra (King of Mountains), and I never saw one that better deserved the name. Never before had I seen such a magnificent range of snowy mountains as here lay stretched before me, and it was with difficulty I could tear myself away from the sight (p. 133).

Closely following Gill came the expedition of Count Szechenyi in 1877–80. His account, published in three volumes in Hungarian between the years 1890–97, was translated into German, illustrated by an atlas of fifteen sheets of routes and topographical sketches (3 vols., Vienna, 1893–97), and seems to be the only systematic account of the country we possess. The surveys were made by Lieutenant Kreitner of the Austrian Army, who gives on p. 60 the following account of his methods, as translated by Mr. G. R. Crone:

A precise triangulation during our journey in Eastern Asia was obviously impossible. Hence I determined the position of conspicuous peaks and summits of mountains and other prominent objects by compass bearings, and, as far as practicable, from several, or one other, similar bearings, plotted the angles graphically. I thus obtained a distance, within the possible limits of accuracy, for the fixed object from my position, in order to ascertain the relative difference of height by measuring the vertical angle. On a rapid journey on public roads, it is

possible only occasionally to set up the theodolite, so a few only of the determined heights were measured with that instrument. I generally used for sighting the corners of my rectangular survey-box, on the reverse side of which I had constructed a quadrant with a 5° scale, or else the compass of the expedition's geologist, fitted with a contrivance for reading vertical angles. Since the distance of the measured point or the approximate vertical angle can in accuracy by no means approach the components of the barometrical determinations, I have in most cases, after correction for refraction and for the difference between apparent and true horizon, rounded them off to the nearest hundred metres. Regarding the heights determined by eye, I admit freely that they have no positive scientific value, but nevertheless they should not be rejected, until a Chinese survey comes into existence. To estimate heights correctly is rather luck than skill, and I can only record that during the journey through the loess region I already doubted my critical faculty for height judging (*Die wissenschaftlichen Ergebnisse der Reise des Grafen Béla Széchenyi in Ostasien* 1877–1880 (Wien, 1893–98, vol. 1), p. 60).

and on pp. 265–6 an account of the country which may be translated thus:

On the south and east the valley [of the Tar-Kjo] was bordered by high mountains, sharp, steep and conspicuous, which, in the main west-east chain, attained over 6000 metres. A mighty glacier, 7 km. long and wide in proportion, invested the imposing mountain and its jagged rock peaks and abysses with special interest. On it were ranged several small glaciers. The snow-covered portion of the main range extended for 65–70 km. from the central "knot," Bokunka, to beyond the meridian of Ta-tsien-lu on the east. While the upper parts of the mountain are bare rock, the spurs are covered with a thin layer of humus, on which sparse brushwood grows. Between Ta-tsien-lu and Tscheto only a few pasturing grounds were seen. The range west of Ta-tsien-lu is less steep and, in the summits near the Tar-Kjo valley, reaches a height of 4500–5500 m. . . . The way leads from here (Tscheto) up the north-west valley, and one reaches after four hours, without much strain, the 4499 m. pass, the Dje la, or the divide between the Ya long kiang and the Tatu ho. Right up to the head of the pass dwarf trees grow on the sides (sloping 25–45°), and some 100 metres higher sparse grass. To the north of the Dje la, the rock summits of the Tscheto san tower like a gigantic, completely bare wall, whose relatively low saddles are filled with snowfields. The highest peak lies about 30 km. north-west of the pass, and reaches with a 1000-metre relative elevation above the main chain, the magnificent height of 7800 metres. Its name is Dschara, or "King of mountains." Some 30 kilometres farther north I caught sight a few days later from the pass Dorka La a second peak dominating in equal majesty the main chain. This peak marks the (administrative) frontier of China. Both, with dazzling white snow-covered peak, have a sharp cone-shaped form.

South of the Dje-la pass the rocky chain stretches with increasing height and wildness to the pinnacled Kunka massif, broken by gorges and precipices, which is dominated by the wonderful 7600-metre (absolute) rock pyramid Bokunka. This summit towers about 1300 m. above the angular snow chain, which runs like a half-moon from west by north to east. The chain itself extends still farther, though with less imposing peaks, its grey rock pinnacles also shooting up above the snows (p. 265–6)

The names have been left in the German spelling. In the geological results of Loczy (vol. i, pp. 703–5) we have a little more on Bo-Kunka:

Dson-go lies on a spacious valley bottom. . . . In the southern opening of the valley a high cone stands up, which is very like the Matterhorn, and, to conclude from its shape, formed of granite: its flat surroundings must apparently be formed of such clays and sandstones as are to be found on the similarly formed hills at Dson-go. This stone pyramid which rears itself like a monolith bears the name Bo-Kunka, and on its abrupt slopes snow lies only in a few places. In Fig. 125 the Bo-Kunka is drawn as seen from the Dson-go valley. The snow-covered range lying E.N.E. from it, the Kunka mountains, appears to be gneiss. . . . The triangular mountain group of the Ta-tsien-lu can be overlooked in its whole extent [from Kaschi-La pass], and we can recognize its structure and even its rocks at a great distance with sufficient certainty. In the north-east the panorama is dominated by the gneiss-granite mass of Dschara (Loczy, *Geological results*, vol. 1, pp. 703–05).

These heights for Jara (7800 m.) and Kunka (7600 m.) are, so far as we have been able to discover, the only instrumental heights ever published for these peaks. The details of the observations are given on p. 88. They are evidently the authority for the heights given by E. Bretschneider in his "Map of China . . . to illustrate the author's History of Botanical Discoveries in China, 1896," which shows a mountain south of the Dabo Pass and 30 miles north-north-west of Tatsienlu as 25,592 feet, and another about 25 miles south-west of Tatsienlu as 24,900. But already in the "Second thoroughly revised edition" of this map published in 1900 Bretschneider has dropped the former height, and the latter has since disappeared from later maps, such as the Kiatingfu sheet of the India 1/Million published in 1922.

Kreitner's maps on 1/Million are drawn in the style of the old Austrian 1/750,000, with hachures so heavy that the map is almost illegible. They are full of detail extending about 20 miles on each side of the route of the expedition, and there are many spot heights rounded to the nearest hundred metres. It would seem unfair, in the absence of any equally detailed maps, to conclude that all this detail is unreliable; yet if we make a tracing and superimpose it on the Survey of India compilation of the same scale we observe that Bokunka is very much out of position, and Mr. Stevens is clear that his sketch of Minya Gongka from Yingkwanchai (No. 2) is of the same mountain and in nearly the same aspect as Kreitner's sketch of Kunka from Dsongo (p. 703), which it much resembles. But Mr. Stephens is also certain that the high peak on the extreme right of the panorama from the Haja La (No. 3) is the same Minya Gonka, and the Haja La is south-east of Kreitner's position for Bokunka. That is, he was turning his back on the place of Bokunka when he drew No. 3, and it seems certain that Kreitner's Kunka was much farther from Dsongo to the south-east than he supposed. But this does not help us to diminish the height assigned by Kreitner to the mountain. On the contrary, if the mountain that Kreitner observed was really farther away than he thought, his angular elevation of over 14 degrees would make it much higher than the 7600 metres which he calculated for it; but we are no nearer the solution of the curious fact that Kreitner's figures have gradually, or perhaps rapidly, faded away from later map compilations.

Since his time many travellers have passed through Tatsienlu. Some have been favoured with clear weather as they crossed the high passes which lead from one deep valley to another, and make brief reference to the snows; others

seem to have been less fortunate and have scarcely mentioned them. In the following extracts we have collected most of these references from the more obvious sources, and shall be glad to receive others.

[Rockhill, coming from the north-west from Tailing.]

On the eastern side of this valley rose precipitous mountains, the summits of several of them deep in snow; and at its head was the huge, rugged mass of the Ja-ra ri, with deep beds of snow and ice extending several thousand feet down its steep flanks.

The Ja-ra ri is composed of a cluster of three peaks, and must reach an absolute altitude of about 16,500 feet; its southern continuation forms the Jeto la, over which passes the southern route to Ta-chien-lu. Along its eastern flank are the Ché ch'u and the road we were to follow; the country bears the name of Girong. This name [Ja-ra ri] cannot have the meaning given it by Captain Gill. It appears to me to mean "Horn of China," marking from afar where China commences; or else it is *Chalari*, "mountain of Ta-chien-lu" (W. W. Rockhill, *The Land of the Lamas* (1891), pp. 268–9).

[Johnstone, coming from the east from Hualinping.]

For the remaining three days of my journey to Tachienlu the scenery was of great beauty and grandeur. I have seldom seen anything more magnificent than the view of mighty mountains that greeted me as I left Hua-lin-p'ing, and continued to face me nearly all the rest of the way. The lustre of the snow, the rich azure of the sky and the sombre shadows of the gorges and ravines combined to make a series of pictures which no words can describe (p. 123).

There are times, of course, when the glories of the scenery are hidden by clouds or dimmed by rain and mist, and many a traveller must have gone through this country with very little idea of the wonderfuls ights that were hidden from him (p. 124).

After Ta P'eng Pa there is a long upward climb, followed by a short and sudden descent to a wooden bridge crossing a mountain stream. From here there is a magnificent view of the snowy mountains in the south-west (p. 127).

Tachienlu is a long, narrow little city which has had to adapt its shape to that of the mountains by which it is hemmed in. The summits of these mountains are covered with snow all the year round, and some are very lofty. According to Bretschneider's map, one of them is estimated at 25,592 feet, and another at 24,900 (p. 129).

The road from Chê-to rose steadily, but not steeply, through a confined valley, following the left bank of a stream. About midday we were picking our way laboriously through deep snow, and early in the afternoon we reached the summit of the pass of Chê Ri La, 17,400 feet above sea-level. The pass is a double one, the two summits being divided by a long valley which appears to have been at one time the bed of a glacier. High as we were, there were peaks in the north-east that still towered several thousand feet above us, and to the south and south-west we saw nothing but a vast ocean of billowy mountains with innumerable trough-like valleys (R. F. Johnstone, *From Peking to Mandalay* (1908), p. 155).

[Wilson, coming from the east from Kweiyung.]

With the weather conditions so favourable the view from the summit of the pass far surpassed my wildest dreams. It greatly exceeded anything of its kind that I have seen, and would require a far abler pen than mine to describe it adequately. Straight before us, but a little to the right of our viewpoint, was an enormous mass of dazzling eternal snow, supposed to be, and I can well believe

it, over 22,000 feet high. Beneath the snow and attendant glaciers was a sinister-looking mass of boulders and screes. In the far distance were visible the enormous masses of perpetual snow around Tachienlu. In the near distance, to the west-north-west of the pass, another block of eternal snow reared itself. Looking back on the route we had traversed we saw that the narrow valley is flanked by steep ranges, the highest peaks clad with snow, but in the main, though bare and savage looking, they scarcely attain to the snowline (p. 200).

The mountains on either side of the valley in all their higher parts range above the snowline; their lower slopes are covered with grass, small conifer trees, and brushwood (p. 201).

During the day, which was beautifully fine, we had grand views of the snow-clad peaks around Tachienlu and the steep ranges with pinnacled peaks to the east-south-east of that town (E. H. Wilson, *A Naturalist in Western China* (1913), p. 202).

The frontier town of Tachienlu, where I was stationed for nearly two years, is the gateway through which the teas and silks of Western China enter Tibet. Here, in a narrow ravine hemmed in by steep mountains whose summits are clothed with glaciers, converge the two highways which unite Lhasa with China, the official highway through Batang and the caravan road through Jyekundo (p. 231).

On the way up one catches a glimpse of the magnificent peaks and glaciers to the south-east of Tachienlu, the highest summits of which rise to over 17,000 feet. . . .

Just below the pass we parted from the Batang main road and turned north-west across a stony waste at the foot of a barren range of mountains trending in much the same direction. At its farther end is a fine snow-capped peak called Zhara Ri by the Tibetans (in Chinese Hai-tzu Shan, "Lake Mountain"). Among the tarns which lie at its foot is a beautiful turquoise lake fed by a waterfall issuing from a glacier (Oliver Coales, "Eastern Tibet," *Geogr. Jour.*, 53, 233, April 1919).

Another very prominent mountain feature in Kam is the big range which runs parallel to, and on the right-hand side of, the main road from Jyekundo to Tachienlu. It is a huge and imposing barrier wherever seen. South of Jyekundo it forms the divide between the basins of the Yangtze and of the headwater streams of the Mekong, and is here crossed by the Shung La, a high pass on one of the roads from Jyekundo to Chamdo. Proceeding south-east, it is pierced by the gorges of the Yangtze below Chunkor Gomba (Tengko) and thence serves as the Yangtze–Yalung divide down to below Kantze. On this stretch of its course it contains some very high peaks and glaciers behind Dzogchen Gomba, below which it is crossed by the Tro La on the main road to De-ge. Farther down it appears as the magnificent snow-capped range which stretches along the southern side of the Yalung plain from Rongbatsa to below Kanze; in this neighbourhood it is crossed by the Tsengu La and the Hön La on the road to Beyü and Southern De-ge, and by another high pass on a road to Nyarong. Below Kanze it is pierced by the gorges of the Yalung, which are overlooked by a giant snow-peak, Kawalori, a sacred mountain of Nyarong. From here it continues south-east to Tachienlu, where it serves as a clear-cut ethnographical boundary between Chinese and Tibetan inhabited country; it is here split into two by the valley of the river of Tachienlu, which is overlooked by snows on both sides. From Tachienlu it continues south, containing here some very big peaks, towards the Yunnan border. I suspect this great range to be a south-easterly continuation of the Dang La

mountains north of Lhasa, and to be therefore one of the principal features of the mountain system of Tibet.

There are some very high mountains on both sides of the Yangtze between De-ge Gonchen and Batang, including the giants immediately east of the latter; but I have not been able to distinguish the continuity of particular ranges in that neighbourhood.

It is to be hoped that the heights of the principal mountains of Kam will some day be ascertained by scientific measurement, the results of which will probably show the existence of some very high peaks. I believe that amongst the highest will prove to be the group of peaks behind Dzogchen Gomba (bearing roughly north from the Mizo La near Beyü); Kawalori on the Yalung below Kanze, some of the peaks on the Mekong–Salween divide between Chamdo and the latitude of Atuntze; the peaks east of Batang; and the peaks north and south of Tachienlu (Eric Teichman, "Journeys through Kam," *G. J.*, 59, 1 January 1922).

Mr. A. E. Pratt ('The Snows of Tibet,' 1892) remarks that on the way to Tatsienlu from Wassu "views up various ravines disclosed snow-capped mountains," and that north of Tatsienlu the snow-line is at about 16,000 feet.

Dr. A. F. Legendre (*La Géographie*, 15 Dec. 1911) gives heights of passes but little about peaks and no heights or names of peaks on his map. Mr. Edward Amundsen (*G.J.*, 15, 620), going S.S.W. from Tatsienlu, speaks of a succession of mountain ranges clothed with luxuriant pine forests, but makes no mention of any high peak.

Major H. R. Davies (Yunnan: C.U.P. 1909) came over the Gi La to Che-to and descended "a narrow green valley to Tachienlu . . . shut closely into a narrow valley by high steep hills," but neither in his book nor the accompanying map (T.S.G.S. 2112) are there any high peaks.

One may gather from these extracts why our knowledge of the mountains about Tatsienlu is very defective. The valleys are deep; the passes are often wrapped in cloud; the visibility is generally poor. If so good a traveller as Mr. Oliver Coales could be stationed two years at Tatsienlu and afterwards write a paper on the country with such slight references to these peaks, they must be very inaccessible, and seldom seen.

Mr. Herbert Stevens had better weather than usual, and we are much indebted to him for the following note, which gives the best account of this country since Szechenyi's journey more than fifty years ago. He cannot assign any height to these peaks, but his sketches show that they are of striking form; and we may hope that they will inspire a survey of the ranges at the first opportunity.

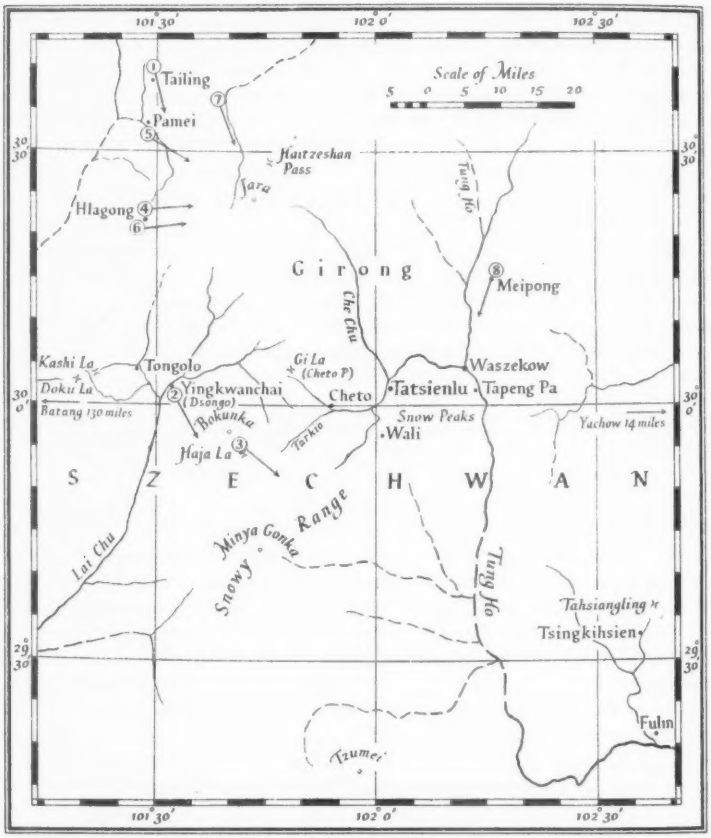
SKETCHES OF THE TATSIENLU PEAKS

HERBERT STEVENS

IT was my good fortune to be a member of the Kelley-Roosevelts' Expedition to Yunnan and Szechwan. To enable our party to work to the best advantage, in accordance with pre-arranged plans we separated en route and, for me, finally at Likiang, owing to my missing connection at Tatsienlu. The collection of zoological and botanical specimens was my first consideration; but, owing to the time required by these duties, and exceptional climatic conditions giving good visibility which must have been phenomenal for a time of year under the influence of the south-west monsoon, I saw much of the country traversed to perfection. Our party left Bhamo on 26 December 1928, arriving in nine days at Tengyueh. I left this place a day later than my companions, and after crossing the Mekong struck easterly to Mingshih, taking fourteen days to reach Tali, where our party was again united. It took five days via Kienchwan to reach Likiang. On March 7 I left Likiang, spending fifty-five days en route in camp and thirty-eight days on the march, via Yungning, Muli, Kopadi, Kulu, Kon La 14,600 feet, Yonka La 15,000 feet, Tiyu 12,900 feet (Gompa), Yatsu 11,200 feet, Baurong 8000 feet (Rope ferry below village), Patei (Pass 15,300 and 15,000 feet), Wushi 12,000 feet (Pass 15,000 feet, descent to 12,700 feet, Pass 15,600 feet), Kusata (Gompa), Chentze 13,100 feet, Laila hamlet 12,400 feet, Chaulu 13,600 feet (Gompa), Lai Chu (Bridge), Zamba Ku 11,600 feet (bridge, stone towers, open valley), Trazya 12,100 feet, Haja Tungu 13,000 feet (Gompa), Haja La 15,300 feet, Cheto, to Tatsienlu, where I arrived on June 1. After work at two camps near at hand, Cheto and Wali, I was joined by my friend Huston Edgar on two journeys. The first was through the Tibetan Borderland via Cheto (Pass 15,000 feet), Anyangpa 12,900 feet, Yingkwanchai 12,400 feet, and Tongolo 12,500 feet, where we left the Batang track and struck north to Pehsang 12,500 feet, Chengmengka 12,700 feet, Hlagong 13,300 feet (Gompa), Pamei 12,300 feet (Gompa), Tailing 12,600 feet (Gompa), Kwanchai 13,700 feet, from which place on our return we went south with a diversion east to Tailing, crossing the Haitzeshan at 15,000 feet on the eastern side of the Jara mountain, Sintientze, Tsongku, to Tatsienlu: time on march eighteen days. The second journey was east to Waszekow, where we turned north following the right bank of the Tung Ho to Kutsa (Gompa), crossing the river by ferry-boat at Chingshui 6000 feet, stiff ascent of 3800 feet to ridge circ. 8500 feet overlooking Meipong 7900 feet, descent followed by stiff ascent of 3800 feet to ridge overlooking the Tung Ho gorge at 10,800 feet. From this point our route continued north-easterly with descent to Tienta 9000 feet, river crossing above hamlet 7400 feet, small gorge, perpendicular crags on right, Kochaihopa 7500 feet, Trashichoten 8300 feet (Gompa), Shwang Yu 8900 feet, Tongling 8800 feet, the last house to the west of the watershed; camp in river-bed 9800 feet, Santochai camp 11,500 feet, Lianghokow (remains of single house, open grasslands 12,200 feet), gradual rise to 13,100 feet, followed by a sharp descent in a south-easterly direction to Tupakö 7400 feet, Laoyingkö 6500 feet, Pashku 5400 feet, Moaten 4400 feet, to the town of Muping 4000 feet, thence to Yachow via Lingkwang, Renjaba and Feihsien. (Innumerable hanging plat-

forms, tree-trunk bridges, and one rope crossing.) Time on march twenty-one days. I reached Shanghai on 6 November 1929.

Early in the year, when traversing Yunnan, distant snow-capped mountains had been seen to the north; and when I arrived at Likiang and camped during February in the village of Ngulukö, some 12 miles north at the base of the mountain Satsetö, the glaciers and snow-capped peaks of the Likiang Range



Sketch-map showing positions from which Mr. Stevens' sketches were made

were seen at comparatively short range, the summit of Satsetö being visible from the narrow street in the village. Another peak Ginalakö is visible from the track which runs north and south over the plain about half a day's journey to the north.

On the evening of March 25, from my camp at 12,000 feet, two and a half days' journey south of Muli, this range could be clearly seen on the horizon 80 miles to the south. On the morning of April 23, after leaving Kulu, an impressive

view of a massive snow-capped range, somewhat obscured by clouds, was obtained from open country at 12,500 feet looking west-north-west, which range the lama who was accompanying me called the Shola Gonka; while on the afternoon of the 30th, when between Yatsu and Baurong before the descent to the gorge of the Yalung, I had an impressive view to the east of snow mountains, which the lama and carriers spoke of as the Minya Gonka, evidently a portion of the same range which I was later to see to perfection: the culminating mountain admits of no error in identification under favourable circumstances. On May 31 my caravan, comprising villagers, yaks and ponies, left the village of Haja Tungu and were laboriously traversing a long ascent on a track with an execrable surface little better than that of a moraine, when I decided to forge ahead. On reaching the narrow gap on the summit of the Haja La, with the first gust of wind over came a butterfly (Parnassius), a genus I had not met with up till then. On coming through the gap I was held spellbound by the utter solitude and sterility of a range of mountains, fantastic in shape and outline. I had immediately to make the most of a double opportunity. Leaving my boys to the difficult task of netting as many insects as they could catch on the screes in a high wind, I ascended the ground on my left, where a blue Meconopsis was sparingly in evidence, working in the direction which would be likely to disclose a more extensive view to the south-east. After gaining some 200 feet I was amply rewarded with the view of the pyramidical snow mountain shown in sketch No. 3. My camera had failed me before reaching Yungning, but my sketches are substantially accurate to the best of my ability. My altitudes are only approximate from aneroid readings.

From above Wali, some 15 miles south of Tatsienlu and north of the Yajajen Pass, on June 30, I had hoped to get a view to the south-west of the dominating peaks of this same range, but the weather was not propitious, and though I obtained a momentary glimpse of what was most likely this particular peak, from this direction it showed a slightly inclined summit with a steep face on my left while the opposing face was almost perpendicular. [Perhaps the Ru-ching of Gill.]

It was not until the afternoon of July 15, when at Yingkwanchai, that Edgar and I saw to perfection the same mountain, figured in sketch No. 2, showing from this viewpoint as a pyramid completely covered with snow, in a southerly direction; a rough guess would place it about 30 miles away. Again from Tailing about 2 miles north of the monastery, on the morning of the 26th the whole range was visible as in sketch No. 1. There was every indication of an extensive glacier to the left of the culminating peak.

Another imposing mountain, at the extreme end of this bend of the Himalaya to the north of Tatsienlu, is Jara, which was seen first from the west of Yingkwanchai at an elevation of 14,500 feet, a portion of the summit being disclosed in a north-north-easterly direction; but it was not until we reached a point south of Hlagong monastery on July 19 that the whole mountain mass above the perpetual snow-line was revealed to the east in all its majesty, and though less of it was seen from our camp July 19–22, to the north of Hlagong, later at Pamei on the evening of the 23rd it was seen to perfection. The Tibetans speak of this mountain as higher than the Minya Gonka, probably owing to its isolation. Judging by the amount of perpetual snow,

some of these mountains are very high, and in shape are eminently beautiful. On the evening of August 3 from our camp at 13,000 feet Jara appeared to block our route to the south, and the following evening when we camped on the Haitzeshan pass at 15,000 feet, we had nearer views of its glaciers and snow when we pitched camp in a perishing blizzard. Early next morning a few glimpses were obtained, but soon the clouds settled, and in our descent south it was soon lost to view. Nearing Tatsienlu on the evening of August 6, a snow-peak of this same range was visible from one viewpoint some 7 miles north of Tatsienlu in a south-south-westerly direction, which would be a peak of the same group as seen from our mid-day halt on August 20, after leaving Meipong, on the mountains above the left bank of the Tung Ho looking south-west 200° (Sketch No. 8). These mountains are visible from water-level at certain points on the Ya river, and there is also an excellent view from Omeishan; but whether the commanding Minya Gonka is visible from the summit of Omeishan I am unable to say. It was blocked by a shoulder of the mountain when I stayed at Shihshahshu on October 5 to 9; but I did manage to obtain a fleeting glimpse of the peaks in a west-north-westerly direction.

[The sketch-map is based upon the Survey of India 1/M sheet Kiatingfu, with additions depending on rough compass traverses. The positions from which the sketches were made are shown by numbered circles, and arrows show the general direction. The bearings given in the titles of the sketches are magnetic, but the variation at Tatsienlu in 1929 was very small, about 0° 25′ west by the Carnegie Institution Survey brought up to date with approximate secular change. Mr. Stevens had the assistance of Mr. Edgar in recording the names, and considers that Minya Gonka is near the correct spelling. The name Tatsienlu of the Chinese Postal Guide is pronounced Dachienlu.]

CANADIAN GEOGRAPHICAL SOCIETY

THE newly formed Canadian Geographical Society held its inaugural meeting at Ottawa on 17 January 1930. The President, Dr. Charles Camsell, was in the chair, and the Governor-General (Lord Willingdon) honoured the proceedings with his presence.

Dr. Camsell, in opening the meeting, said that for some years past Canadians had had in mind the formation of a Geographical Society for the advancement and diffusion of geographical knowledge, more particularly relating to Canada. Such a Society had now been formed, and he looked forward to its being of great service to Canada. He also read out a telegram of greetings to the Canadian Geographical Society from the President and Council of this Society.

Lord Willingdon congratulated the Society and said he hoped it would enable Canadians to know more of Canada. He had had to travel much about the country, and he was surprised to find how little those living in one part knew of other parts of their own country. This deficiency the Society should help to make good.

Dr. Isaiah Bowman, Director of the American Geographical Society of New

York, conveyed to the Society the good wishes of his own Society. Sir Francis Younghusband, who had been invited by the Society to be their guest of honour at the inaugural meeting, then described his Mission to Tibet in 1903–4, and at a second meeting held on January 20 he presented to the Society a Tibetan sword with a silver scabbard.

That the new Society is fulfilling a popular wish is shown by the fact that though the inaugural meeting was held in the largest hall in Ottawa there was a greater demand for tickets of admission than could be met, and a second meeting had to be rapidly organized. And, contrary to the custom in our own Society, the public are admitted (on payment) to the meetings, the idea being to arouse widespread popular interest.

The officers of the Society are: Vice-Presidents, Dr. Mackintosh Bell and Mr. C. P. Cowan; Hon. Secretary, E. S. Martindale; Editor of Journal, L. J. Burpee; Hon. Treasurer, F. C. T. O'Hara. The first number of the *Canadian Geographical Journal* is being published this month. The Society aims at making it both scientific and popular. They wish the papers to be of real scientific value. And they will endeavour to make it attractive by the reproduction of first-class photographs and pictures.

BIOGRAPHY OF CAPTAIN SCOTT

CAPTAIN SCOTT. By STEPHEN GWYNN. (Golden Hind Series.) *London: John Lane.* 9×6 *inches;* x+240 *pages; portraits and map.* 12*s* 6*d*

IT is perhaps a compliment that Captain Scott should now be ranged with Elizabethans such as Drake, Hawkins, and Grenville in the Golden Hind series, the first of the moderns to appear in that company. Certainly Mr. Gwynn has had an easier task to find material for this biography than had the authors of those earlier lives, but, nevertheless, his whole task has been far more difficult, and the reader of this book will soon realize just how difficult it was.

The book consists for the most part of extracts from Scott's letters and other writings linked together by paragraphs by the biographer himself, and as far as the facts of such an active and eventful life are concerned it is complete. Indeed, those who knew Captain Scott will be pleased to read of incidents and traits of character which are new to them and go far to explain some of the attributes of his character. In such respects the biography is a success, but if it be the duty of a biographer to present a complete picture of his subject, to accord his doings with his character and to show the reader exactly why his life took the course it did, then this book is incomplete. It presents us with a puzzle rather than a picture, but we must hasten to say that that cannot be altogether laid to the blame of the biographer.

It is debatable whether a man's writings are ever a complete index to his character, and in the case of a complex character like Scott's they will certainly tend to give a very one-sided view of the man himself. This was evident when Scott's diary was printed word for word in the narrative of his last expedition, for his companions on that expedition were amazed to read in his diary the myriad doubts and anxieties which had never shown themselves on the surface. In fact, the diarist, having done his day's work during which he was the clear-sighted leader without doubts or fears, seemed to have changed his character when in the sleeping-bag he began to review the events of the day past and to forecast the events of the day to come. This curiously double existence is shown up in still

greater relief in a life which is really told from his private letters, and in some sense it becomes an injustice to the man himself, for it presents him as querulous and hesitating when nothing of the sort was evident on the surface. The balance could only have been adjusted by including in the book more opinions on the man from his fellows and giving a greater space to the lighter side of his character.

There are indeed two great hindrances to a satisfactory biography of Scott: the first is that his great but tragic death inevitably colours any picture of his life, and the second is that he was by training if not by nature almost a double personality. It were easier to write two separate lives of this man, one as a naval officer and successful explorer, the other as a kindly gentleman, an enthusiastic seeker after knowledge, yet subject to the ups and downs of temperament.

To combine the two aspects in one biography is indeed a difficult task. As a result of his deeds, together with what has been written of him, Scott will always appear as a kind of paradox, for he was a great leader and careful organizer, and yet his qualities did not really fit him for these positions. Thus, the really successful explorer must be ruthless towards animal life, but Scott was not; he was, in fact, over-careful, for his temperament would not permit any suspicion of cruelty to animals. The really great leader of men is able to unbend occasionally with his followers, but Scott could rarely do that, for his naval training would not allow him to do so. The ideal organizer and traveller would not take risks which might be thought almost foolhardy, yet Scott did so, for that was the tradition of his service, and to come back after a journey with more than an ounce or two either of energy or food in hand was to him a sign of failure to do his utmost. Yet in spite of these inherent disadvantages he certainly was a great leader, a great traveller, and a great organizer, though in becoming so he wore himself out by the prodigious effort required to make one side of his character work together with the other. All this is shown by a careful study of the material presented in this biography, but the ordinary reader will only get a one-sided picture of the man himself.

The picture of Scott as given in Cherry Garrard's 'Worst Journey in the World' is in its way a truer one than can be obtained from this formal biography, but even that intimate sketch fails to show how extraordinarily good a companion Scott could be. In both one misses the occasional prank, the quick witticisms, and the genial attitude to his fellows, which were just as much a part of the man as his plannings, his search for information, and his anxieties. The reader of this book would, for instance, have difficulty in imagining Scott racing up and down slopes near his headquarters and rolling on the snow with his dog companion, or running up to one of his junior officers engaged on a plane-table survey, addressing him by his nickname and ragging him about cold fingers and the intricacies of his work. Such incidents were indeed rare because by immemorial tradition a naval leader must be isolated and unbending; but in his family life his real self must have been much more apparent, and it is a pity that Mr. Gwynn has not lightened his book by more anecdotes of this type. Altogether the book is a trifle disappointing in its omissions, and though it must be welcomed it cannot be regarded as a great or complete biography.

There is not much to comment upon in detail: there are a few misprints and inconsistencies which are too trifling for special mention. There are, however, one or two technical errors which somewhat mar the book. Thus, on p. 55, the author says that Arctic sledging is done over the "comparatively smooth surface of sea ice," and we are led to believe that this is an easy matter compared with sledging over the surface of the Barrier, "so long solidified that this snow surface is like that of land." The real facts are that Arctic sea-ice is very rarely smooth, and the obstacles of pressure-ridges and open leads makes sledging there far more

arduous than on the Barrier, where the surface is just plain snow, soft or hard, according to recent winds.

Occasionally in the book one is given the impression that naval service is the ideal training for polar exploration. If this were the opinion of an expert it might be worth controverting; as it is it may be left to the opinion of the reader, who will be aware that it is the man himself and not the training which makes the great explorer. F. D.

LANDFORMS OF CENTRAL AND SOUTHERN FRANCE

LE PLATEAU CENTRAL DE LA FRANCE ET SA BORDURE MÉDITERRANÉENNE: Étude morphologique. By HENRI BAULIG. *Paris: Armand Colin* 1928. 10×7 *inches; 590 pages; illustrations, diagrams, and maps*

IN writing the history of the Earth's crust, geologists properly regard the rocks themselves, their character and their fossils, as the chief sources of material. Hitherto comparatively little attention has been devoted to the physical history of regions of the crust during periods of their emergence, for which the data must be sought mainly in the record of denudation. This record is to be read by the study of the surface form, generally the existing surface, but sometimes one that has been buried by later deposit and is now visible either here and there in geological sections, or, as in the case before us, over wide stretches of exhumed peneplane. In the future geomorphology will surely play a greater part then formerly in the reconstruction of the geological past. The present work points the way. In the first place it represents a painstaking examination of evidence, both stratigraphic and tectonic, collected largely by previous workers, but evidently considerably augmented by the author's own purely geological field work; and this he has supplemented by very extensive critical observation of the land forms and the drainage systems all over the ground. Secondly, the author has reviewed the evidence as a whole for each of the component parts of the Central Plateau and its southern border, and by his deductions has at once pieced together the physical history and given an excellent description and a logical explanation of the land forms.

So far, the work is certain to receive from an ever-widening circle of serious students unstinted praise and almost complete approbation on account of its profound analysis of surface features, and for the impetus it will surely give to geomorphological study, as well as from the novelty of some of the facts it reveals for the first time in this region.

The matters emerging in the body of the work which will as surely arouse controversy are those which are summarized in the conclusion that is ultimately reached, and towards which the reader sees the author progressing through some 500 pages. Baulig, marshalling his evidence from each district, seeks some comprehensive explanation for the initiation of a series of separate incomplete erosion cycles to which he assigns, first, certain smooth platforms on the borders, and secondly, the valleys of stepped character throughout the Plateau. But he discards the upward movement of this area of the Earth's crust as the cause; the facts, he repeatedly asserts, are not in accord with such an explanation. And so he has recourse to the eustatic theory. Movements of the universal base-level—the ocean surface—are postulated amounting to nearly 500 metres, beginning in the early Pliocene period with a level at least 100 metres below the present datum, rising then to +380 m., and subsequently subsiding by stages to its present position.

It should be said at once that, whether this striking conclusion be ultimately accepted or not, it may be welcomed as an incentive both to the re-examination of other regions whose forms have hitherto been otherwise accounted for, and to the exploration of undescribed areas with a view to testing its validity. For obviously, if Baulig is right, the homologues of his marginal platforms and interior valleys may be found in all continents wherever more recent differential movements of the crust have not occurred.

But the reputation of the book will not stand or fall with the conclusion. On the contrary, there is no chapter without its permanent value to the reader who takes the trouble to give it serious study; and certainly no geomorphologist can afford to neglect it.

The opening part, of 85 pages, contains: first, a sketch of the structure, form and subdivisions of the Plateau; secondly, a good summary of its geological history; and thirdly, a classification of the land forms under the following headings: *Formes construites ou d'accumulation; formes de dislocation; formes structurales; formes d'érosion cycliques*. This section is a concise statement of wide general application; incidentally, in a footnote, we find the author resorting to English to propose the term "erosional fault scarp" as a substitute for the "fault-line scarp" of W. M. Davis. Fourthly, the available maps, profiles and other data of levelling are reviewed. In regard to this it is important to remember that Baulig's investigation had to be made with the *Carte de l'Etat Major*, 1/80,000, the drafts (1/40,000) on which it was based, and the reduction from it, 1/200,000. On the former map relief is shown by spot heights which, apart from triangulation points, may have errors up to 30 metres, and by hachures. On the latter map form-lines at an approximate interval of 20 m. are used, these having been drawn in the office on a map of 1/50,000 in the first instance. It is therefore a misfortune that the re-survey of France had scarcely reached the region. The author will be the first to admit that when the new contoured maps are available for the Central Plateau a revision of his work will be most desirable. And one cannot but feel that he may then be led to different conclusions on minor and even on major questions. The ground for this statement is that in a morphological investigation of this character and minuteness, altitudes both absolute and relativs, are all-important, and Baulig, without a contoured map, had to rely for these upon spot heights except along important stream lines which had been surveyed by levelling. He has used the spot heights by an ingenious method consisting in plotting as a graph the frequency of places of given altitude found in the zone chosen for study. Of this method it is difficult to judge without having used it; and although the author, in an appendix, shows by text and diagrams how the graphs serve to bring out the various peneplanes of Brittany, he does not demonstrate their application to the Central Plateau. None of the curves of height frequency which he made is reproduced, and there are no diagrams to help the reader to appreciate the exact limits and the character of the peneplanes. Yet the recognition of these is one of the chief contributions of the research.

In mentioning this matter of illustration one must of course remember the difficulty of bringing a work of this kind and size to publication in any form; and the special prints of six sheets of the 1/200,000 map, covering most of the region discussed, are admirable in many ways. They show the form lines (black), the hydrography (blue), and (in red) such geological information as is regarded as pertinent, notably fractures. But for the sake of clearness, all names save those of the chief rivers, are omitted, likewise all altitudes. Hence, the reader has no guidance as to the surfaces, and in particular the marginal platforms of Languedoc, so important to the discussion, are not even covered by any of the six sheets. Moreover the reader cannot follow the detailed account of the valleys without frequent

reference to other maps carrying names. A sheet of twenty-nine geological sections of the Plateau shows selected heights but gives no indication of the identity of peneplanes, no geological key, and no map of section lines.

The five sheets containing a very large number of longitudinal river profiles are not only exceedingly clear but are also more helpful when read along with the standard maps of the region. These profiles are of great interest. The main lines of them are constructed, for the major streams, from levels officially determined but largely unpublished; other parts of the stream profiles drawn from the maps being of course less reliable. On all the profiles, broken lines are drawn to indicate reconstructions of the former (and higher) thalwegs now represented by the existing headstreams of the stepped valleys and by the ledges on the sides of the present incised lower portions. The evidence for the reconstructions is to be regarded as variable in amount.

It must be confessed that the reader unfamiliar with the region has considerable difficulty in following the arguments district by district in view of the defects in illustration already mentioned. Nevertheless the author is worth following, for there is no question about his equipment for the severe task he set himself in the field. We have not space here even to outline the content of his regional chapters. For a good summary of this reference may be made to the longer review of the work by Professor de Martonne.* We cannot even enumerate the varied subjects dealt with; the aggregate amount of matter relating to the development of the river systems is alone very great; or again, the sections on the Causses of the south are full of new material. But throughout the work it is the character of the valleys and the peneplanes that receive most attention, and some consideration must be given to this subject.

Since Carboniferous times Central France has undergone two periods of great crustal deformation. The first resulted in the folded Hercynian mountain system; the second, marked by the uprising of the Pyrenees and the Alps, was here a period of great dislocation and volcanic activity, but not of folding. The intervening epochs were occupied by alternations of denudation and marine transgression, the full extent of the latter being unknown. To the history of this period of relative crustal stability Baulig by his work has contributed the fact that twice the rocks were worn down to a senile surface; for he has disengaged from one another, apparently unquestionably, the remnants of two peneplanes which intersect at small angles. The older represents the worn-down Hercynian folds, while the younger is of early Tertiary age, and truncates the Mesozoic sediments as well as the older peneplane. From the nature of the superficial materials it is shown that in both cases the denudation was effected in a warm climate with a pronounced dry season. Moreover in each case the peneplane became buried, the earlier, under sediments of Secondary age, the younger, partly under the debris of contemporaneous deposit and partly by the products of its own weathering remaining in place. These peneplanes are now both visible because they have been gradually exhumed by later denudation. They have however been severely dislocated, especially in east and south, by the mid-Tertiary crustal disturbances which severed the massif into a number of fault-edged blocks. The scarps thus formed have long since disappeared from the outer parts, but many have reappeared as erosional fault scarps. Baulig brings much evidence to show that these movements ceased with the Miocene and, apart from the volcanic outbursts which continued, the later sculpture of the Central Plateau is to be attributed to subaerial processes and especially to the existing river system which was thus initiated in the Miocene.

**Annales de Géographie*, No. 212, 1929, pp. 113–132.

The history of post-Miocene evolution is therefore to be read in the valley forms everywhere, and in the erosion platforms of the border zone, especially in the south-east. The main thesis of the work, then, is that the record is unmistakably one of successive waves of erosion working upstream along all the valleys, each wave to be correlated with a base-level that is approximately identifiable by the marginal platforms. The valleys, from the accounts given, do seem clearly to be the composite products of several periods of rejuvenation; and the author in general appears to be well justified in his correlations as between the different river systems. But it is more difficult to follow him in tracing the correspondence between the valley steps and the broad platforms of the margin. These, however, are undoubtedly remarkable features in themselves; they are, without a doubt, erosion surfaces; and all who have looked critically, for example, at the almost flat platform of the Garrigue of Bas-Languedoc and wondered as to its origin will welcome Baulig's work here. The Garrigue surface marks but one of a series of "levels" described between the Plateau and the Mediterranean and Rhone valley, and extending into Provence. Among them the most pronounced are said to stand in altitude at about 380, 280 and 180 metres respectively. Others being recognizable at 250 and 150 metres. They are held to have been cut, not by the sea itself but by rivers flowing at gentle slopes near to sea-level. Sea cliffs are in fact absent. Because of the so-called horizontality throughout their length—a matter difficult to prove without precise levelling—and on account of the breaks of slope between the various terraces, the possibility of their representing portions of one peneplane subsequently warped and dissected is dismissed. It would seem, however, that geologists will find it difficult to believe in a *Massif Central*, to say nothing of its south-eastern border, remaining undistorted and unmoved by the Alpine thrusts that continued long enough to disorder the Pliocene rocks of the mountain edge to the east.

In support of the local evidence in favour of eustatic movement of sea-level in later Pliocene and Pleistocene time, the author adduces the observations of others from far afield. Such, for instance, are those of Mengel, who reported shore-lines at 280 m. on both sides of the Pyrenees (in Roussillon and in Ampurdan); and again the benches noted on the flanks of the Sahel of Algiers by de Lamothe (and figured by Baulig in one of the geological sections given). These are found at the same levels as the terraces in Languedoc, and one of them (at 280 m.) is cut upon Lower Pliocene deposits.

Baulig's challenging treatise presents a timely argument in favour of the eustatic hypothesis, for many workers are now engaged in elucidating terraces on coasts and valleys in many countries. But, whatever be the verdict on this question, we may conclude by expressing admiration for the long-continued effort of investigation from which the book results, and belief in the soundness both of the greater part of the observations recorded and of very many of the deductions made. If we assume that the resurvey of the region and a re-interpretation of the facts ultimately lead to rejection of eustatic movements as the initiators of erosion cycles, and to the acceptance of, shall we say, epeirogenic uplifts in their stead, surely the mass of Baulig's evidence will find a very large place in the final exposition of the region's history.

In the meantime may it be suggested to Professor Baulig that he take pity on the foreigner who has little personal knowledge of this fascinating Plateau, and that he publish a brief summary of his main discoveries? One would ask specially for a few simplified maps and diagrams, and above all for a map of the whole area showing the position and extent of the erosion surfaces recognized.

A. G. O

REVIEWS

THE PHYSIOGRAPHICAL EVOLUTION OF BRITAIN. By L. J. Wills. *London: Edward Arnold* 1929. 9×6 *inches;* vi+376 *pages; illustrations, diagrams and maps.* 21*s*

The title of this book does not do justice to the amazing amount and variety of information with which it is packed. The evolution of Britain is certainly the theme of the whole work, but anything which may throw light on that evolution finds a place in it. Thus Part I is a condensed treatise on Physiography and Stratigraphy in general, in accordance with the most modern ideas and phraseology: no one in future, for instance, will have the right to complain that he cannot find the meaning of the term "sima." At appropriate places in the other parts are expositions of the continental-mobility theories of Wegener and others, and of the nappe theory of Alpine structure.

The author boldly emancipates himself from the rigid chronological fetters in which almost all books on stratigraphy are bound, but without repeating Lyell's unfortunate attempt to tell a story backwards. He starts with the Carboniferous period and traces the evolution of Britain on to the present day; then he goes back to the pre-Cambrian and works up to the first starting-point. This originality of method is thoroughly justified. The numerous text-figures are admirably clear: many are original, the rest from widespread sources and often with improvements by the author.

There is very little that calls for criticism. The author follows a prevalent fashion among geologists in too easily attributing movements to isostasy: thus on p. 128, local upward movements in a heavily sedimented and generally sinking area are described as "isostatic." On p. 107 the use of "homotaxial," though certainly in accordance with Huxley's original definition, seems to reduce the term to absurdity. Comparing English Bunter with German Bunter, or Keuper with Keuper, the absence of fossils forbids us to say that they are contemporaneous, except in a very rough way; and if we may not say they are homotaxial (*i.e.* identical in sequence or arrangement), we want a third term, and "homotaxial" had better be dropped. The author writes of Argand and Staub as "adopting Wegener's theory" (p. 180), without pointing out the fundamental change involved in substituting a northward for a westward continental drift: a reader who, not realizing this, tries to reconcile the Permian geographies of Figs. 37 and 78 will have an unhappy time. Lastly, we are surprised that an author so up to date in general, should, in dealing with glacial phenomena, make no reference to the striking work of Dr. G. Slater.

These are small defects in a book which should be read and kept for reference afterwards by every one who wishes to understand modern geological ideas.

A. M. D.

ALBANIA: the Rise of a Kingdom. By J. Swire. *London: Williams & Norgate* 1929. 10×6 *inches;* xxiv+560 *pages; illustrations and maps.* 30*s*

Though this book contains little of strictly geographical interest, it is none the less a very useful addition to the literature dealing with Near Eastern politics, for Mr. Swire is the first writer in recent years to handle his subject in a comprehensive manner.

The book is made up of four sections. The first deals with early history, the national awakening and the struggle for autonomy actually realised during the first Balkan War of 1912–1913. The author lays stress upon the long-standing local desire for education, and points out that the Albanian opposition to the

Young Turks was one of the primary factors rendering possible and leading to the original success of the first Balkan War.

The second section covers the earlier independence and the brief reign of Prince William of Wied. In some way this is the best part of the volume. There was no time before the war for any serious treatise to appear, and since the Armistice that particular phase of Albanian history has been almost forgotten. It has been too much the fashion to ignore the difficulties and merits of this ruler. The author of this work takes a fairer and broader view of matters which we can now discuss with a certain impartiality.

It is impossible here to enter into the details of the two later phases—the world war and subsequent period. The country was invaded by a variety of armies; the Serbs and the Greeks are said to have left no stone unturned to put an end to Albanian Independence, and it is contended that the territory on the east of the Adriatic has been and is the cause of much rivalry and ill-feeling between the governments of Rome and of Belgrade. There have also been internal differences, the history of the last ten years records many changes of régime, and the State, at first in a transitory condition and later a Republic, has now been declared a Kingdom. About all these conditions and changes the author has a great deal of knowledge to impart.

Lord Cecil is right in expressing a hope, in a letter to the author, that the book will be widely read. Though the detailed information presented is a little heavy and not always well arranged, the material has been collected with care and the volume is undoubtedly well worth intimate study.

A chronology of modern events is given, there is an excellent bibliography, and the maps and index are useful and adequate. H. C. W.

SULLE ORME DI MARCO POLO. By GIUSEPPE CAPRA. *Turin: Giuseppe Anfossi*, 1928. 10×7 *inches;* 548 *pages; illustrations and maps.* L.40

Marco Polo has so long been an international figure that we regard him primarily as a European, as the traveller who "discovered Asia for the European mind." We are apt to forget that he was also a national hero. Perhaps the greatest traveller of all time, it is only natural that Italians at the present day should regard him with very real pride. The present book is a straightforward account of an Italian's journey across the continent of Asia from Tientsin to Milan, a journey which follows closely the route taken by Marco Polo, at least between Peking and Samarqand. The itinerary of the expedition is clearly shown in two simple folding maps. A start was made from the port of Tientsin in May 1926. The railway was followed via Peking to Hankow, then a short journey up the Yangtze, then a cross-country journey by motor to the Han valley, then by country boat to Hsiinyang, then across the Tsinling to Sian, via Pingliang to Lanchow, and by the usual route through Kansu as far as Ansi. Here the expedition left the route of Marco Polo and travelled north-westwards to Qomul (Hami), Turfan, Urumchi, Qara Shahr, and along the line of oases to the north of the Tarim basin through Aqsu to Kashgar. From Kashgar the Terek Pass route was utilized with the help of horses and railhead was attained at Osh, the remainder of the journey being performed by railway through Russian Turkistan and Russia to Moscow, and from Moscow via Berlin to Milan. The description follows the route closely, and the first part is of value and interest as giving an insight into the state of affairs in the interior of China in the troubled year 1926. The author's snapshots form a suitable complement to an interesting travel narrative.

L. D. S.

IM LAND DER STÜRME: mit Yak- und Kamelkarawanen durch Innerasien. By E. TRINKLER. *Leipzig: F. A. Brockhaus*, 1930. 9×6 *inches; 242 pages; illustrations and map. M.*15 (*unbound M.*13)

'Im Land der Stürme' is an account of Dr. Trinkler's Central Asian Expedition of 1927–1928 written in a style similar to his 'Quer durch Afghanistan.' He has wisely left all serious reference to scientific matters till the time when he proposes to publish the scientific results. The expedition was organized in 1927 and lasted actually for a little over a year. Dr. Trinkler was fortunate in securing the services of Dr. de Terra, who undertook the geological investigations, and of Monsieur Bosshard, who was responsible for the photographic and botanical work. The author devoted his attention chiefly to the physical geography of the regions traversed. It can be seen that the party, though few in number, were well equipped for an expedition to these parts. Many explorers during the past fifty years have travelled to Central Asia, but even to-day our scientific knowledge of the region is small, due no doubt to the fact that those who went were not trained in scientific matters. There are therefore many gaps which we hope Dr. Trinkler will fill in, and we look forward to the time when his scientific results will be published.

The party started from Srinagar, and after fitting out at Leh for the journey across the Lingzithang plateau, left on July 12 for Kashgar. An unusual feature was the inclusion of seventy sheep in their transport. The author writes in glowing terms of the use of sheep in the higher altitudes of Central Asia. There can be no doubt that were it not for the endurance of these animals, the party would have found themselves in dire straits. During the course of the journey across this desolate plateau only three sheep died, whereas thirty yaks out of a total of thirty-one succumbed. Dr. Trinkler was fortunately able to obtain fresh transport from some friendly Qirghiz and eventually reached Kashgar early in December. The expedition here divided into two for the Western Taklamakan and the Kunlun, so that each member could carry out his own scientific observations. The end of May 1928 saw them back again in Kashgar, and early in July they left for India, going via the Karakoram pass. Monsieur Bosshard did not accompany the party home, but had the unpleasant task of escorting the heavy baggage direct to Europe via Russia.

It is of course impossible to state what scientific results have been achieved, but one can safely say that Dr. Trinkler must have added considerably to our geographical and archaeological knowledge of these parts. Dr. de Terra also has evidently valuable geological data to put at our disposal, and we have proof of Monsieur Bosshard's work in the many and excellent photographs which form one of the strong features of the book.

In 'Im Land der Stürme' the author describes his personal experiences and those of the members of his party. He has the happy knack of holding his readers' interest, and even though at times repetitions occur, they do not weary as is so often the case in travel books of this kind. One very striking point is Dr. Trinkler's treatment of the carriers. He has a firm but friendly manner with them, and realizes that their welfare and comfort are even more important than his own. The success of this expedition was largely due to his tact in the handling of them.

A reference must be made to the manner in which the book has been produced. The publisher, although one of the leading firms in Germany, has seen fit to use German type. Surely a book of such international interest should be printed in Roman type to facilitate reading. The book has otherwise been brought out extremely well. The photographs are excellently reproduced, and Monsieur Bosshard is to be especially congratulated on this part of the work. There are in addition a few coloured plates of water-colour sketches by the author which add to the value of the book. An excellent index and itinerary map are to be found at

the end of the volume. The spelling on the map of places in Kashmir, Ladakh and Central Asia has a peculiarity of its own, and the reviewer confesses that he is at a loss to follow the system used. In spite of this, however, 'Im Land der Stürme' may be put in the front rank of travel books. B. K. F.

LANDMARKS OF THE DECCAN: A Comprehensive Guide to the Archaeological Remains of the City and Suburbs of Hyderabad. By SYED ALI ASGAR BILGRAMI, ASAFJAHI. *Hyderabad: Government Central Press*, 1927. 10×7 *inches; 226 pages; and illustrations. Rs.5 or 8s*

This volume purports merely to be a comprehensive guide to the archaeological remains of the city and suburbs of Hyderabad. The author, both as an official of H.E.H. the Nizam's government and as acting Director of Archaeology in that State for two years, has had full opportunity of making himself acquainted with the monuments he describes. Of the 76 monuments, which have been arranged as far as possible in order of age and classified in respect of their importance, with all inscriptions copied and translated, no less than 34 are of Golconda, the older capital of the Qutb Shahi dynasty, which lies some 5 miles west of Hyderabad. The chief value of this compilation lies in the photographic reproductions of the inscriptions, which have been very clearly printed, and in the amendments suggested in the readings in some cases. The historical Retrospect (pp. 187–203) cannot be said to be of much merit. Plans of Hyderabad and Golconda, showing the site of each monument, would have been useful to visitors and tourists. Maps should be added if the proposal to prepare similar lists for the outlying areas of the State materializes. C. E. A. W. O.

THE MUHAMMADAN EMIRATES OF NIGERIA. By S. J. HOGBEN. *Oxford: University Press* (*London: Humphrey Milford*) 1930. 9×6 *inches;* xiv+204 *pages; and maps.* 10*s* 6*d*

GAZETTEER OF ILORIN PROVINCE. Compiled by the Hon. H. B. HERMON-HODGE. *London: George Allen & Unwin* 1929 (1930). 9×6 *inches;* 302 *pages; illustrations and maps.* 21*s*

In his introduction to Mr. Hogben's work Mr. H. R. Palmer, the Lieut.-Governor of the Northern Provinces of Nigeria, tells us that the primary object of the book is that it should be read by pupils in the Nigerian Schools, so that they may learn the relation of the history of their country to the history of the world in general. In attempting to achieve this laudable object Mr. Hogben set himself a difficult task in which he has not been wholly successful.

The first part of his book is devoted to an account of Arab civilization, to which the author gives a prominence out of proportion to its importance to his subject, and a general survey of Western Sudan history. Throughout it is apparent that Mr. Hogben, probably through lack of opportunity, has not studied his subject deeply, his reading evidently having been restricted to English authors. Owing to the facilities which their African Empire affords them, the French have done far more work than we have on the history of Northern Africa. Yet the whole of their considerable literature, with the somewhat infelicitous exception of the works of M. Felix Dubois, appears to have been neglected by Mr. Hogben. Had he made a slightly closer study of his subject he would not have told us, for example, on p. 30, that near Mali "were the towns of Jenne and Tekrur, the exact identity of which is vague; possibly they were one and the same town." Tekrur was, of course, the important Tucolor kingdom on the lower Senegal which was such a valued ally of the Almoravides in the eleventh century. And Jenne still flourishes, as Mr. Hogben recognizes on p. 43, where he gives a very misleading account of its modern appearance with houses which "are clearly

imitations in wood and clay of the stone architecture found in ancient Egypt," a passage which bears the unmistakable stamp of Dubois.

The second part of his book is a detailed account of the history of each Emirate, and is based on the very valuable provincial gazetteers which the political department have produced. It will be convenient to many to have the more important historical information which they contain presented in this concise form. Mr. Hogben has added a bibliography, but the less said of this the better. Before giving further instruction in the history of Northern Africa, he will do well to peruse the works of such writers as MM. Gautier, Gsell, Chudeau, and Delafosse.

Mr. Hermon-Hodge's book is one of the Nigerian provincial gazetteers already referred to. Like the rest of this valuable series it gives a mass of detailed information about everything which concerns the Province—geography, history, ethnology, native administration, land tenure, fishing rights, trade, agriculture, forestry, etc.

A compilation of this nature, even when edited with the literary skill for which Mr. Hermon-Hodge is distinguished, is unlikely to find many readers, but it is of great value to every one interested in the region of which it treats. Ilorin has two particular claims to interest. Firstly it represents the most southerly extension of Fulani dominion, and secondly a great part of it is inhabited by the proud and warlike Borgawa, who for many centuries successfully withstood the aggressions of formidable neighbours. Probably the first European to visit their country and return with his life was Lord Lugard, whose delightful address to this Society in 1895, describing his celebrated journey to Nikki, will be remembered by some of our Fellows. Mr. Hermon-Hodge quotes this address at considerable length in his opening chapters. The illustrations are good, but the map is not up to the standard of the rest of the work.

FROM COAST TO COAST BY MOTOR. By PAUL E. VERNON. *New York: William Edwin Rudge* (*London: A. & C. Black*) 1930. 8×5 *inches;* xi+116 *pages;* 8 *illustrations in colour from photographs, and map.* $2.50

This is an account of a motor tour from coast to coast of the United States by a citizen of that country. Intermingled with it are reminiscences of earlier adventures and incidents, which hardly make for continuity of reading. The descriptions are somewhat meagre and the book cannot be said to contain much of geographical interest. It may, however, be found useful to any one essaying a similar journey.

A. W. S.

TWENTY-FIVE YEARS IN SOUTH AMERICA. By E. F. EVERY, D.D. *London: Society for Promoting Christian Knowledge* 1929. 9×6 *inches;* viii +212 *pages; illustrations and maps.* 7*s* 6*d*

As its title implies, this is less a book of descriptive travel than of personal reminiscence. Bishop Every had charge of the Diocese of the Falkland Islands, which at that time included the whole of South America, for the first quarter of the present century, and his duties led him to many out-of-the-way spots not usually visited even by the ubiquitous commercial traveller. In latter years the Bishopric was divided, the Falkland Islands with their wholly British population of 2000 being selected as the nucleus for the Pacific Coast, while the East Coast diocese naturally centred in Buenos Aires, since Argentina is reputed to harbour some 40,000 British people, the same diocese covering Brazil, with various colonies of Bermudans located in the Amazon valley.

The author gives the lay reader some idea of the organization necessary for Anglican congregations in this vast district and the methods by which our English Church unit of the parish is stretched to Brobdingnagian proportions.

The subject of church attendance by English people in Latin countries and the effect which the growing cult of games has on the Sabbath, on which unfortunately, they can best be played, is treated as fairly as so personal a matter admits. There is a good story of the founding of the first Anglican Church at Rio in 1810, against which the Papal Nuncio of the day strongly protested. The Bishop of Rio held an opposite view. "The English have really no religion at all," he said; "but they are a proud and obstinate race. If we oppose their wish in the matter they will not only persist, but make it a question of infinite importance. If, on the other hand, we give way to them, they will build their chapel and no one will ever go there."

Despite a full index, the reader unfamiliar with the ground is likely to be bewildered, being hurried on various topics from Peru to Magellan and thence to Brazil or Paraguay in somewhat breathless fashion. Those who are better acquainted with the country will mistrust such generalizations as that the Englishman married in South America reverts to native stock in three generations. The eulogy on the work of the South American Missionary Society is perhaps natural, since to its pioneer and founder Allen Gardiner and to the work of the Rev. W. H. Stirling the founding of the South American bishopric of the Anglican Church was chiefly due. Yet the Society's work in Magellan died with the dying out of the Fuegan tribes: its work in the Chaco will end in a similar manner: and the only native population which has shown itself able to withstand contact with white, the Araucanian tribes of South Chile, are frankly abandoned by the Anglican Church to the Salesian Missions. But Bishop Every does not deal with South America solely from the standpoint of a bishop. Indeed, in South America a bishop must also be a very human person and a "good mixer." That he had all these qualities and the saving leaven of humour, which relieves so much of the minor discomforts of travel, these pages amply testify. The book is illustrated by well-chosen, if somewhat familiar, photographs. W. S. B

FOUNDERS AND PIONEERS OF SOUTH AUSTRALIA. By A. GRENFELL PRICE. *Adelaide: F. W. Preece & Sons* 1929. 9×6 *inches;* xii+266 *pages; illustrations and map.* 12*s* 6*d*

Mr. Price has in several earlier works dealt with the history and the environment of his State—rightly, because the origins as well as the development of South Australia differ sufficiently from those of other Australian States to need separate treatment, and valuably, because this author's experience and natural impartiality fit him for his somewhat arduous task. In his latest volume he departs (perhaps unconsciously) from the accepted method of most Australian historians, and in nine short but pithy biographies of South Australia's pioneers makes it clear that that State was really founded by explorers and adventurous settlers, not by speculative or theoristic politicians and their subordinates. The tragic struggles of Governor George Gawler, a man with sound notions about the processes of settlement, against the bewildered doctrinaires of the Board of Commissioners, are soberly narrated, and one's only regret is that the author's sympathy for the badly treated Gawler leads him into undue depreciation of a greater man, George Grey. Grey was tactless, and misunderstood Gawler almost as completely as did the authorities in London, but his services to Australia and to the Empire are too undoubted to be belittled.

This, however, is an old quarrel, and Mr. Price does little to throw fresh light on it. What he does, and does well, is to place Charles Sturt, and William Light, and the agents who carried out in the new colony the settlement schemes of George Fife Angas, in their proper place as chief builders of its eventual prosperity. On the work of Angas himself, both as planner in London and as settler in

South Australia, much new information is drawn from sources hitherto unused. William Light, "the most romantic and pathetic figure in South Australian history," receives his due as the man who did more than any other pioneer to counteract the blind haste and extravagant optimism of the Board of Commissioners; his choice of the site of Adelaide is his best-remembered achievement, but Mr. Price shows how many other claims he had to the eulogy of Chief Justice Way . . . "preserver and saviour of the State." Francis Cadell also, whose name is probably unknown to many Australians and most British readers, is at last given credit not only for his persistence is opening up river traffic along the Murray but also for his explorations in the Northern Territory, absurd as the then prevailing opinion in Adelaide—at the other end of the continent—chose to consider them.

In the reviewer's opinion more maps and fewer portraits would improve the book greatly; reproductions of ephemeral caricatures and very poor portraits (that of Gawler is a monstrosity) have little interest nowadays. But, as it stands, Mr. Price's volume is of great value, and the publishers' part in it sound and praiseworthy. A. J.

THE ECONOMICS OF AUSTRALIAN COAL. By F. R. E. MAULDON. With an Introduction by D. B. COPLAND. *Melbourne: University Press and Macmillan & Co.* 1929. 9×6 *inches;* xvi+280 *pages; diagrams and maps.* 10*s* 6*d*

This monograph is an excellent piece of work. No trouble has been spared in collecting detailed information on the spot, in culling reports from other countries for relevant comparative material, and in sifting the whole so as to present a systematic and very readable account of a tangled subject. Mr. Mauldon writes primarily as an economist whose business it is to get at the essential facts, and either to draw from them the necessary conclusions, or better still, to let these facts speak for themselves.

Valuable as this book will no doubt prove as an economic survey of an important industry in distress, it incidentally contains much first-rate economic geography. Almost the whole of the first part, in fact, comprising quite half of the text, might stand with but little re-editing as a comprehensive yet clear treatise on the geography of coal-mining in Australia. In this section the industry is given not only its local but also its world setting. Every important aspect is dealt with, and full references are given as to sources of information. Thus, for example, the striking fact is explained that whereas in 1913 New South Wales coal was among the cheapest in the world, to-day it is among the very dearest.

The analysis of the troubles of the Australian coal industry, which is his central theme, leads Mr. Mauldon to the consideration of other factors beside the purely material, "The whole situation," he exclaims bitterly, "is an impasse of frustrated wills." On the last page he remarks that "nothing less than the subjugation of economic motive to higher social motives can rid our industrial and commercial life of its crudities"—wise words which require sounding as much apparently in Australia as elsewhere. E. W. S.

LA MER DU GROENLAND: Croisières du *Pourquoi Pas?* By J. B. CHARCOT. *Paris-Bruges: Desclée de Brouwer et Cie* 1929. 10×7 *inches;* 210 *pages; illustrations and maps.*

Dr. Charcot's book describes three of the recent voyages of the *Pourquoi Pas?* Built in 1907–8 for exploration in the Antarctic, his well-known ship is still in active use, either on hydrographic cruises or, as described in the present book, on expedition work in Arctic seas. In 1925 Dr. Charcot was successful in reaching East Greenland under what appear to have been unusually difficult ice conditions. An account is given of the early stages of the Eskimo colony at Scoresby Sound.

As an appendix to this section there follows a description of Rockall, visited by the author in 1921, one of the few occasions apparently on which it has been found possible to land on the rock. A second Arctic expedition, also to Scoresby Sound and Jan Mayen, was made in 1926, and on this occasion Captain Ejnar Mikkelsen accompanied Dr. Charcot as additional pilot and friend. Numerous references are made to recent events in Jan Mayen; and it is evident how much the author is attracted to this lonely and interesting Arctic island. These voyages brought such close acquaintance and familiarity with the East Greenland ice that it was obvious that the *Pourquoi Pas?* should be one of the ships commissioned to search in 1928 for Amundsen and Guilbaud and the missing French *Latham* machine. Dr. Charcot accordingly received orders to take his ship to the East Greenland Sea and search the pack edge that summer. The extracts from the log-book of this last voyage make particularly interesting reading and give an excellent picture of navigation in the pack and weather conditions along the edge.

J. M. W.

SCIENTIFIC RESULTS OF THE NORWEGIAN ANTARCTIC EXPEDITIONS, 1927–1928 AND 1928–1929. No. 3: On the Geology and Physiography of some Antarctic and sub-Antarctic Islands. By OLAF HOLTEDAHL. *Oslo* 1929

Professor Holtedahl's memoir is the first publication of a series which will deal with the scientific work carried out on the first two voyages of the *Norvegia*. It will be recalled that on its third voyage the *Norvegia* was quite recently met near Enderby Land by Sir Douglas Mawson in the *Discovery*. All three expeditions, following the lead in such ventures given a century ago by the Enderby Brothers, have apparently been financed by Consul Lars Christensen; the present publication is subsidized by the Nansen Fund and published by the Norwegian Academy of Science.

Professor Holtedahl regrets that it was not found possible to allow of his visiting more than a few localities; in the Palmer Archipelago he was more or less confined to Port Lockroy, three days were spent at Deception Island, a brief landing made at Clarence Island, and a longer visit paid to South Georgia. From all except Clarence Island preliminary geological collections are known; Holtedahl however has added very materially to the geology of all four localities. He has, in fact, no need to apologize for the hasty nature of his visits; collections in the past have been scanty, and the present memoir not only improves our knowledge very considerably, but shows also the advantage of a visit to the Antarctic of a seasoned observer with long Arctic experience behind him.

The general account of the physiography of South Georgia is excellent. In this connection Holtedahl holds strongly to the view that the bedded rocks of the island are as at present known of Mesozoic age only. He is a firm believer in the hypothesis of a South Antillean arc, of which South Georgia and the other Falkland Island Dependencies are the fractured remnants, not necessarily continuous formerly one with another, but fragments probably of a series of concentric arcs. This view, which is widely held, gains additional support from the soundings recently taken on the *Meteor* expedition.

The statements, that Deception Island is a caldera and that Bouvet Island is a single volcano with several centres of eruption, are both new interpretations; the mysteriousness of Deception Island disappears, and its true history and nature are at last made clear. Elsewhere in the South Shetlands observations were confined more to the nature of the glaciation and to the topographic history. A new glacier name, "Antarctic ice-mantle type," is proposed; to English readers, however, the name at first sight suggests a different meaning from that which the author

has in mind; and in effect the glaciation in question seems a variety merely of Highland ice. Some interesting observations are made on "foreland glaciers," and the theory is put forward that cutting back by glaciers of this nature may possibly be the explanation of the "strand flats" in Norway; the investigation of the latter by Nansen is well known, and they have generally been regarded as due to marine denudation. This is not the only comparison made between northern and southern regions: not only have the author's experiences in Spitsbergen and Novaya Zemlya largely helped to a more modern and sounder view of many of the features of the geology of the Falkland Dependencies, but in turn it appears that his Antarctic voyage has now enabled him to return to Norway with new equipment for a fresh study of Scandinavian problems. J. M. W.

EARTH FLEXURES: their geometry and their analysis in geological section, with special reference to the problem of oil finding. By H. G. Busk. *Cambridge: University Press* 1929. 10×7 *inches;* viii+106 *pages;* and *illustrations.* 12*s* 6*d*

The nature of this work is sufficiently indicated by its sub-title. It is intended primarily for the field geologist who is already acquainted with the elements of geological survey. The greater part of it is devoted to a very clear exposition of the more precise methods of constructing geological sections which have been developed in recent years, chiefly on account of the requirements of oil-finding. This part of the book is admirably adapted for its purpose, but is necessarily technical in character. The last chapter, however, is of wider interest. It describes the geological structure of selected areas, examined by the author himself, in Burma, in Persia, and on the eastern margin of the Gulf of Sinai. The first is an example of simple folding, the second of complex folding and overthrusting, and the last of simple normal faulting. Perhaps the most interesting features described are the thrust-sheets or nappes now forming in South-Western Persia, and the reader's attention may be drawn to the sketch on p. 91, showing the actual appearance of an advancing nappe. Those who are familiar with the structure of the Subhimalayas will notice other analogies, and the reader cannot fail to wish that the great oil companies who allowed Mr. Busk to publish the notes in this chapter would permit the publication in full of the work of their geologists. But this, no doubt, is too much to expect in present circumstances. P. L.

LA NOUVELLE CYTHÈRE (TAHITI): Journal de Navigation Inédit. Journal écrit à bord de la frégate du Roy la Boudeuse, commandée par M. le Chevalier de Bougainville, par C. F. P. Fesche. (Avant-Propos de Jean Dorsenne.) *Paris: Duchartre et Van Buggenhoudt,* 1929. 8×6 *inches;* xxx+34 *pages; illustrations and chart.* 18 *fr.*

When Diderot called Louis de Bougainville "a true Frenchman" he was careful to explain that the great navigator's enthusiasm for Tahitian customs was a special proof of his nationality. In the same spirit, no doubt, M. Dorsenne has extracted from the journal of one of de Bougainville's fellow-voyagers the section narrating the visit to Tahiti, and expounding in language more outspoken and enthusiastic than his commander cared to use the remarkably frank and free behaviour of the islanders. M. Dorsenne's object apparently is to rescue de Bougainville's reputation from the charge of exaggeration brought against him by some more recent visitors to the Society group, who have found both less freedom and less noble savagery under French rule; he therefore quotes Cook (though "le sévère Anglais n'était guère accessible au pittoresque") and Commerson, and gives us Fesche's version in full. The book adds nothing of importance to de Bougainville's narrative, but makes pleasant reading as the unaffected outpour-

ings of a high-spirited youngster in fairy-tale surroundings. Even as thieves he cannot help admiring the Tahitians, whether they purloin two muskets and a large copper out of a tent full of sailors or—more piquantly—distract the commander himself with the attentions of three damsels while they carry away his achromatic spyglass.

Several illustrations are borrowed from de Bougainville's original narrative; the rest modestly echo the spirit of M. Fesche. A. J.

LIVINGSTONE. By R. J. CAMPBELL. *London: Ernest Benn* 1929. 10×6 *inches; 370 pages; illustrations, portraits, and map. 21s*

Dr. Campbell has been able, with the help of unpublished material, to draw a new portrait of David Livingstone. This portrait does not differ very greatly from those with which we are familiar, but it throws into fuller light the unity of purpose of the great missionary traveller, the man more responsible than any other for the changes which have taken place in negro Africa during these last momentous eighty years. Dr. Campbell also shows the little human weaknesses of his subject. Livingstone's iron will led him on occasion to disregard the interests of others whom he should have considered, and admittedly his white companions in the Zambezi expedition did not find him an ideal leader. (His attempt to force a passage through the Kebrabasa Rapids is a fine example of his doggedness, carried beyond the limits of reasonableness.) A fellow-missionary in Bechuanaland, Livingstone's senior by many years, revealed much when in a letter home to the London Missionary Society he declared that he refused any longer to be made an "appendix" to his youthful colleague.

The author adds nothing to the record of Livingstone's geographical or scientific work, nor was that his object. His new material includes the whole of the London Missionary Society's archives relating to Livingstone, the private correspondence with Horace Waller (the editor of the 'Last Journals') and Waller's own memoranda on his relations with Livingstone; also the "locked" journal of the Zambezi expedition—locked for security, not because it contained anything Livingstone wanted to conceal. Dr. Campbell has, further, obtained much new information concerning Livingstone's ancestry and early life, and of this he has made good use. This new material, it will be seen, concerns mainly the personality, rather than the achievements, of Livingstone, and Dr. Campbell has done well in making his biography a life in its "specifically personal aspects." There is indeed evidence that the author is not a specialist in things African. For instance, he uses the word "Bantu" as equivalent to negro; tells us that "England hoisted her flag in South Africa in 1802"; and that Paul Kruger became President of the Transvaal in 1853. The style occasionally employed might also be criticised. Like many writers, the author has an irritating way of using the phrase "the latter"—there are two bad examples on p. 323; and, though it be true, it is surprising to read of the Victoria Falls as a "majestic natural phenomenon." Readers of his book will however be grateful to him, for he has made Livingstone, the man, better known, and of the world's great men few can stand as well as he the fullest inquisition into his actions and motives.

F. R. C.

THE PITCAIRN ISLAND REGISTER BOOK. Edited with an Introduction by SIR CHARLES LUCAS. *London: Society for Promoting Christian Knowledge* 1929. 9×6 *inches; 180 pages; and map. 7s 6d*

Pitcairn Island was occupied in 1790 by the *Bounty* mutineers. The occupation was discovered in 1808 by the American whaler *Topaz*. In 1823 John Buffett, a sailor in the British whaler *Cyrus*, was left on the island to work as schoolmaster, most of its inhabitants being unable to read or write, and he accepted as part of

his duties the compilation of a register of "Births, Deaths, Marriages, and Remarkable Family Events." As he began with the original occupation, he must obviously have depended for his earlier entries on local recollections, probably those of "John Adams," the only surviving mutineer, who died in 1829. In 1839 the Register was taken over by George Nobbs, who had migrated to Pitcairn in 1828 and eventually became its first resident clergyman as a missionary of the S.P.G. In 1854 he found the Register too dilapidated for further use, so copied the contents into a new book and presented the original to his friend T. B. Murray, one of the secretaries of the S.P.C.K., who placed it in the Society's archives. Thence it has been drawn to be the first of a series of reprints from that large and interesting reservoir.

The Register Book has been often used as a source-book by writers on Pitcairn, but only in extracts; to have it complete, *verbatim et literatim*, in an accessible form, is an occasion for gratitude. It includes not only the Buffett-Nobbs Register but also a list of prices obtainable on the island (given in dollars and cents) in 1834 and a List of Shipping Entries between 1823 and 1853. This is evidently in the main the work of Mr. Nobbs, but the occasional entries made by visiting skippers are of particular interest; more especially informative is one made by a brother of the famous Baron de Thierry, who was left behind with five others after a boat accident by the barque *Pilgrim* in December 1849 and was picked up by the *Reaper* in April 1850. As might be expected, most of the visiting vessels were whalers, usually American; indeed, Sir Charles Lucas suggests that the book has a special value in connection with the American whaling industry, and Sir Everard im Thurn contributes to it a valuable Appendix on this subject.

A notable feature of the Register is its reticence. Buffett evidently meant what he said when he mentioned "Family Events"; the tragedies of the first ten years are touched on as briefly as possible, and the startling and important episode of Joshua Hill's dictatorship passes unnoticed. On the other hand, the health of residents (mostly ill health, as would be natural in so inbred a community) and accidents to them, with the treatment applied, are expatiated on, and a landslip in 1845 gets three pages to itself.

Sir Charles Lucas's Introduction is excellent, as it should be with such an author; and the map of whaling grounds in the Pacific, originally prepared for the Royal Geographical Society, usefully illustrates the importance of the island to visiting whalers.

A. J.

ROUND THE WORLD ON A CYCLE. By KAI THORENFELDT. Translated from the Danish by ERLE LUNN. *London: Selwyn & Blount* (1928) Ltd. [1929]. 9×6 *inches;* 288 *pages; illustrations and sketch-map.* 15*s*

This is the story of the adventures of a young Dane, Kai Thorenfeldt, who set out on a second-hand bicycle to go round the world. The book modestly claims to be only a log-book and not a scientific work, and the descriptions of places are necessarily somewhat disappointing. But the author passed through some comparatively wild parts, such as Albania, across the mountains from Burma to Siam, through Cambodia, Cochin-China and Annam, and across Brazil to Chile. He met with much kindness and generosity en route, and this, combined with his courage and perseverance, made a successful end possible. The journey took two years and eight months to accomplish, which shows much endurance on the part of the author. His account bears unmistakable signs of genuineness and makes excellent reading. There are a few curious mistakes. "Cambo Santa" should be Campo Santo"; Sao Paco Marcos is not a Latin name; nor is Johore an island. Snapshots taken by the author and a map help one to follow the long trail.

A. W. S.

THE GROWTH OF THE WORLD AND OF ITS INHABITANTS. By H. H. SWINNERTON. *London: Constable & Co.* 1929. 7×5 *inches;* 211 *pages; and illustrations.* 5*s*

This little book attempts too much for its size, and would probably have been better if it had been confined either to the growth of the world or to the evolution of its inhabitants instead of trying to deal with both. The thirty chapters into which it is divided are so short that the reader scarcely has time to become interested before his attention is diverted in a new direction. But with the limitations of space imposed upon him the author has done his work well. His style is clear and easy and he is careful to avoid the use of technical terms without explanation. Only one seems to have been overlooked. "Tissue" in its biological or anatomical sense is not self-explanatory, and is apt to puzzle those who meet it for the first time. It is a little surprising that a geologist should say that Lyell laid the foundation of modern geology, as if there had been no Hutton or William Smith before him. P. L.

GREAT NAVIGATORS AND DISCOVERERS. By J. A. BRENDON. *London: George G. Harrap & Co.* 1929. 9×6 *inches;* 282 *pages; and illustrations.* 7*s* 6*d*

Mr. Brendon relates briefly the careers of a score of seamen, from Hanno to Sir John Franklin, most of whom also rank as discoverers. Published originally in a popular journal, his chapters are confined to the merest outlines, and make no pretence to present fresh portraits of their subjects. Nor are his facts always correct, or his views up to date. He writes, for example, of Columbus that "It is tolerably certain that in 1470, some 6 miles off the coast of Portugal, a Venetian galley attacked and sank the ship which he (aged nineteen) was then commanding." The date of this fight was 1476, and there appears to be no authority for the assertion that Columbus was then in command of a ship. His marriage is placed by Vignaud in the year 1478 and not 1474, as here stated. There is little evidence that he sought aid from Genoa before going to the Spanish Court. Other small points may be noted. Marco Polo is stated to have dictated his narrative in *French* to 'Rusticiano': this is on the face of it improbable; but apparently arises from the existence of early French texts. In the account of the Franklin relief expeditions no mention is made of Dr. John Rae, to whom the government award was given, though the offer of the reward is recorded. It is to be regretted that there should be these slips: the lives of the seamen are spiritedly recorded, apart from a few blemishes of style. What was said of Bligh may be applied to most of them: "Give him pencil and paper, and he'll find his way home from anywhere." An excellent feature is the number of well-chosen illustrations. G. R. C.

HAKLUYT'S VOYAGES. Selected and arranged by A. S. MOTT. *Oxford: Basil Blackwell* 1929. 8×6 *inches;* vi+318 *pages; illustrations and maps.* 7*s* 6*d*

In this excellent selection from 'Hakluyt' we are given an interesting series of the voyages, ranging from John Cabot's discovery of "Prima Vista"—involving the "first successful crossing of the North Atlantic"—to voyages to the Mediterranean, Drake's voyages, and finally the various expeditions and adventures which lead up to "The Beginnings of the British Empire and the American Nation."

While the choice of the passages selected is distinctly commendable, many readers will hardly appreciate the modernization of spelling and punctuation. They will feel that this process is apt to destroy the atmosphere which seems essential to the most effective method of telling the tales. For these accounts from Hakluyt are early tales told in an early style, and to modernize that style, however capably, must inevitably detract from the true felicity of the original itself. A

careful survey of this useful book scarcely serves to endorse the claim that "the actual wording . . . has not been altered." Nevertheless, to produce so attractive a volume at so very low a price is a venture on which the publisher is warmly to be commended. W. W.

A GEOGRAPHICAL GRAMMAR. By C. C. CARTER. *London: Christophers* 1929. 9×6 *inches;* xvi+120 *pages; diagrams and maps.* 3*s* 6*d*

This work attempts to set out those elementary facts of geography which can and should be learned by all school pupils up to the stage of the School Certificate Examination, and to provide exercises for learning them. It marks, and will help, the reaction against the "woolliness" of much geographical teaching, and it will be very useful to those teachers who wish to make their work more definite. Most geographers will agree with the author in his selection of most important facts, though there is room for difference of opinion on some. We should have preferred to have diagrammatic world maps drawn on an equal-area net. And the use of the term "actual" temperature to denote "mean surface" temperature may mislead some pupils.

The book is well got up, with clear diagrams. It has no index. For a first edition errors and misprints are rare. The author has earned the thanks of teachers of geography. C. B. F.

MAST AND SAIL IN EUROPE AND ASIA. By Lieut.-Commander H. W. SMYTH. *Edinburgh and London: William Blackwood & Sons* 1929. (*New edition.*) 9×6 *inches;* xxiv+536 *pages; and illustrations.* 25*s*

The appearance of the first edition of 'Mast and Sail' twenty-three years ago marked a period in the struggle for existence of vessels relying on the winds alone for their motive power. The second edition describes the more stabilized position that is now apparent in the domain of "mast and sail" on the European and Asiatic seaboards. Sailing craft, which suffered extremely in the Great War, are now practically limited to the smaller class of coasting traders and to fishing-boats where the industry is still undeveloped on a large scale. Changes in design and rig, which may be the outcome of competition with mechanical power, are noticed by the author, and fuller information is afforded of the great variety of sail-driven boats which have been the subject of his study. The numerous examples he describes and illustrates form a unique record of this branch of knowledge, and the comments upon the reasons for many types of both hull and rig, their dependence on locality and resources, and the use to which they are put, are highly interesting and show a wealth of knowledge and research not often equalled in essays on maritime practice.

The book cannot fail to inspire the reader with some of the author's love of the sea, and "the way of a ship in the midst of it," and if some may find it difficult to accept without reserve the proposition that the development of sea-going craft and sail is an attribute and mark of superior intelligence or civilization, no one can take exception to the claim that "take the finest sailing coasters, the most powerful fishing-craft, and you will find the inhabitants of the coast-line they navigate are pre-eminent in courage or endurance, or in some branch of thought, art, or manufacture, by which they will leave their mark among the races of the earth.'

The book contains a useful bibliography and glossary of sea terms and a highly satisfactory index. It is a worthy memorial to the "great and ancient brotherhood of sail" as evolved by experience throughout the ages to meet particular features of men's needs. M. T T.

THE MONTHLY RECORD

THIRD GENERAL INDEX

The General Index to the third twenty volumes of the *Geographical Journal*, volumes 41–60, 1913–1922, will shortly be ready for distribution. It follows the plan of the two general indexes already published, containing, in addition to the main index of personal, topographical, and subject entries, indexes to the papers and articles, and to the maps. As the monthly lists of literature were issued from 1917 onwards as Supplements to the *Journal*, bibliographical entries after 1916 are not included in this volume. The price is 10 shillings (to Fellows 7 shillings and sixpence), and orders should be sent to the Chief Clerk at the Society's House. An Index to the first twenty-four Supplements is in preparation.

CHANGES IN THE COURSE OF THE TRENT

In the *Zeitschrift für Gletscherkunde* for December 1929 the Rev. T. I. Pocock, rector of Bassingham, contributes a paper in English on the "Trent Valley in the Glacial Period," in which, by correlating the different river terraces and glacial drift deposits in the Trent valley, he arrives at certain conclusions as to the changes which the course of the river has undergone. The Trent, one of the three chief rivers of England, rises in that end of the Pennine Chain which runs through Staffordshire. Flowing through the Potteries coalfield it soon passes on to the Keuper Marls past Burton and Nottingham to Newark, whence it meanders past Gainsborough through a wide alluvial plain between the Lincoln Oolitic escarpment and the Red Sandstone upland of Nottinghamshire, to the Humber. In the upper part of its basin it drains the uplands of Cannock Chase in Staffordshire, Charnwood Forest in Leicestershire, and the picturesque Peak district of Derbyshire, receiving the important tributaries of the Soar, Tame, Derwent, and Dove. Almost throughout its course the river is bordered by alluvial drift liable to floods, but the depth of this silt is only about half that which is brought down by the Severn and other rivers of Welsh mountain birth. Below Newark, where there is strong evidence for a buried river channel, the gravel terraces instead of continuing straight down the valley of the Trent enter a gap in a low ridge known as the Graffoe hills and pass into the Witham valley to Lincoln. Mr. Pocock thinks it highly probable that the Trent before the Ice Age followed its present direction to the Humber, but that subsequently its valley was blocked by ice or glacial drift so that the river was compelled to seek an outlet through the Lincoln gap to the Wash. He points out however that the river would be unable to surmount the gap in the Graffoe ridge till the now buried channel at Newark had been filled in. He also mentions other evidence quoted by Jukes Brown to the effect that the Trent did formerly take this route to the sea via the Witham. The communication between the Trent and the Lincoln gap is not entirely severed to this day, for there have been occasions in modern times when the Trent has burst its banks and flooded the streets of the lower city. Mr. Pocock concludes his paper with a consideration of the probable age of the Trent valley ice-sheets in relation to those of other regions in Britain and abroad.

FORESTS OF THE KARST

The outer tracts of the Karst belt which stretches from Gorizia to Fiume have been so denuded of the primitive forest cover that one is apt to regard the Karst as a whole as presenting a more or less bare landscape. But farther inland, towards the borders of Carniola, extensive forests still cover much of the surface, and are the subject of a careful study from a geographical standpoint, by

Sig. G. Cumin, in the February number of *L'Universo*. The still forested belt coincides generally with the upper terraces of the Karst and the mountainous parts of Northern Istria belonging to the system of the Julian Alps. The forests differ somewhat in accordance with altitude, oaks being characteristic of the lower levels (with some chestnuts in parts), while the sub-alpine slopes are covered with broad-leaved forests (in which the beech tends to predominate, especially on the crests, unless kept in check by man), or of such forests intermixed with conifers (black pine, red fir, etc.). The underwood consists of various species (of *Sorbus*, *Euonymus*, etc.), and in tracts of small extent there is a rhododendron-pine association. The primitive condition of the forests has been greatly transformed by man, who, besides cutting down many of the high woods, has changed their composition through his attack on conifers in preference to other kinds. That a part of the old forests has survived is due chiefly to their inaccessibility. A good deal has also depended on the social conditions and form of tenure of the land, the high woods having as a rule been better preserved in the hands of large proprietors or under communal ownership. Much however of the destruction has been due to the precarious condition of agriculture, which has induced owners to eke out a living by exploiting the timber. Population is generally sparse in the forested zone, some tracts being almost uninhabited: as might be expected the communes with most forest show the smallest density. On the whole however the forest communes show a greater recent increase of population than the agricultural, and their prosperity has also made itself felt in adjoining areas where wood-working industries have been started. The proportion between the yield of timber and that of firewood and charcoal differs greatly according to the composition of the woods, *e.g.* 91 per cent. of the produce of the beech woods come under the latter category. The movement of timber is mainly effected by the horse, and the number of horses per head of population is markedly above the average in the forest communes. The general preference for horse transport the whole way from the forests to the saw-mill or railway is due to the absence of roads in the higher parts and the extra expense involved by break of bulk en route. The paper is illustrated by an excellent map showing the extension of the forests, the location of the saw-mills or centres of wood-working, and the main transport lines.

FURTHER EXPLORATIONS BY DR. AND MRS. VISSER

The untiring Dutch explorers of the Karakoram and neighbouring ranges, Dr. and Mrs. Visser, last year undertook a third important expedition to those regions, and, according to a preliminary account of the first season's work in the January number of the *Tijdschrift* of the Netherlands Geographical Society, have been completely successful in carrying out the programme laid down after consultation with the Indian Survey Department, while the party is remaining in the field with a view to another summer's work in 1930. The primary object was the thorough scientific examination of several of the least-known mountain groups in the region of the Upper Nubra and Shyok rivers, with special reference to the glaciation. But geological work was also provided for by the participation of a competent geologist, Dr. Wyss of Bern. Mrs. Visser herself undertook the botanical work, and the party included Mr. Sillem, a capable ornithologist, who was to pay attention to the insects and fishes as well as the birds. A special interest of the leader's was the scientific study of the mountain systems, their subdivision and mutual relations, with a view to the introduction of a more suitable nomenclature than that hitherto in use. No conclusions are yet put forward, but they will be awaited with interest in view of the discussions already carried on in the *Journal* on this subject.

The expedition met with the usual difficulties, but by strenuous work they were successfully surmounted. In spite of late snow on the Khardong pass (which the expedition's caravan was the first to cross in 1929) it was necessary to press on so that the Nubra river might be forded before its water was too high. Here the field chosen was the region of the great Siachen glacier, between the ground explored by the Workmans and De Filippi respectively. In spite of deep-cut valleys and rapid rivers the whole tract was surveyed and the glaciers studied from all points of view, after which the Nubra was re-crossed and certain side valleys of the Karakoram were explored. It was proved that, far from showing the influence of a dry continental climate, this part of the range was clad with a far greater mantle of snow and ice than had been suspected. The next work was the examination of various unexplored glacier-filled valleys joining the upper Shyok from the west, and this ground was reached by crossing the Saser pass and turning southward. The attempt involved real risk through the threatening condition of the Shyok glacier lake (see *Journal*, 74, p. 383), for the party was in the danger zone for 20 km. while traversing the valley. Two side valleys were successfully explored and new ice-fields brought to light, while the ultimate source of the Shyok itself was located.

A postscript to the communication stated that the party had safely reached Suget Qaraul in the Kunlun, en route for winter quarters in Eastern Turkistan, further surveys having been carried out meanwhile. Dr. Visser attributes much of his success to the use, for the final stages, of porters only, in place of baggage animals, and is loud in praise of the efficiency and willing service of the men.

A SAHARAN METEOROLOGICAL RECORD

Accounts of Mr. Francis Rodd's journeys from Kano in Nigeria into the South Sahara appeared in the *Journal* for August 1923 and January and February 1929, and it is stated in the last-named number that the meteorological diary had been lodged with the Meteorological Office. The observations made with instruments lent by the Society contained in this diary have now been discussed by Dr. C. E. P. Brooks and Mr. S. T. A. Mirrlees and published as *Geophysical Memoir* No. 48 of the Meteorological Office. There is a preface by Mr. Rodd himself giving an outline of the expeditions in 1922 and 1927 and a condensed account of the country travelled, which lay for the most part in Aïr between 10° and 20° N. lat. and 0° and 11° E. long. The aneroid barometer readings were used for the determination of height, and not for meteorological purposes except during fairly long encampments. Enough pressure curves, however, were obtained to exhibit the characteristic large diurnal range of the barometer of tropical regions amounting to 4 mb., which is many times greater than the irregular changes from day to day, the case being reversed in our latitudes. On only nine days in the two journeys did the maximum day temperature exceed 110° F., the absolute maximum of 114° occurring twice, on 24 June 1922 and 22 September 1927. Once, in December 1922, the night temperature fell below freezing-point. The daily range of temperature is as much as 38° in November, but only 20° in August, the cloudy or rainy period. Sudden changes of temperature with shift of wind—as much as 20° in an hour—also occur. The rainfall diminishes rapidly from 34 inches a year at Kano to less than 15 inches in lat. 15° N., while many parts receive less than 5 inches. The general decrease northwards, however, is disturbed locally by the mountains. The south-west monsoon, which just penetrates as far north as the region in question, is responsible for all the rain that falls there. This chiefly comes between July and September in heavy thunder-squalls or tornadoes, considered to be due to interaction between the south-west monsoon and the North-East Trade.

The most interesting of the records are perhaps those of humidity. The relative humidity varied between 81 per cent. and 2 per cent., and the absolute humidity or vapour pressure between 22 mb. and 1 mb., both showing wide variation, as one would expect in such a region. The high number of mornings with dew in August 1927, the time of year when little cooling is needed for dew to form, is quoted by Dr. Brooks in further evidence of the appreciable quantities of moisture which the South-West Monsoon can transport to the Sahara. But absence of rain in a tropical desert does not necessarily mean absence of atmospheric moisture, and the really remarkable thing is not that the vapour content should at times be high, but that it should fall as low as the lower extreme quoted above. For unless the air is descending from higher levels of the atmosphere, where it is too cold to contain much vapour (as it doubtless is doing at times of anticyclonic circulation) it is difficult to see how the air in a tropical desert can keep dry, since air currents flowing into the Sahara from warm moist regions cannot always be previously dried out by rain. However, the records show that the air in the Sahara is at times nearly absolutely dry, and this goes far to explain the terribly desiccating character of desert winds.

Dust haze is common and sandstorms are frequent, while mirage is too ordinary to excite much interest.

RAILWAY FOR SOUTH-WEST TANGANYIKA TERRITORY

Mr. C. Gillman's recent 'Report on the Preliminary Surveys for a Railway to open up the South-West of Tanganyika Territory' (London: Crown Agents for the Colonies, 1929. 5*s. net*) covers far more ground than might be thought from the title. It is a document of high geographical value, for the writer rightly holds that such a survey is by no means merely a technical task for the railway engineer, but that economic and political considerations may be of prime importance in deciding on the best line to adopt. He therefore studies the whole complex of geographical and economic conditions which govern the question. As regards general principles he points out that when such a broad survey shows that a country possesses potentialities of development by the construction of a railway, this may be justified even though the railway as such may not pay its way for a long time. Again, as the line cannot touch every point of possible productivity it must be regarded as the central line of a zone of beneficial interest, so chosen as to include as many such points as possible and to ensure that future offshoots can be efficiently joined to the main trunk.

The principal difficulties in railway construction in this region arise from the recent elevation of the crust-blocks, which leads to intensive erosion, producing closely packed, steep-sided valleys with narrow and uneven ridges between; so that the usually preferable "divide-lines" have to give place to "valley lines." Two main alternatives have been under consideration (with variants): an eastern line starting from Kilosa on the Central Railway and, after skirting the highlands on the east, ending at the port of Manda on Lake Nyasa; and a western, starting from Dodoma and crossing the highlands to Fife in North-East Rhodesia. From a general survey of the topography Mr. Gillman concludes (1) that Nyasa can only be reached economically (within the Territory) through the Ruhuhu depression; (2) that the tendency to swampiness in the plains below the scarps must force railway lines into the narrow strip intervening between the scarps and the inundation areas; (3) that this furrowed and fault-ridden area must make any line more expensive to construct and maintain than the earlier railways which followed lines of least resistance. Thus the Dodoma–Fife route involves the crossing of four upstanding blocks and one high mountain pass, so that purely engineering considerations would veto it at once.

Reviewing the climate, soil, and population of the spheres of the suggested alternatives Mr. Gillman dwells on the "instability" of the rainfall, the ruinous effect of soil-erosion due to the native system of agriculture, the large arid areas, and the unevenly distributed population. But whereas the eastern route traverses, for 50 per cent. of its length, the tract at the foot of the great scarp where a more reliable rainfall permits of a denser population, and for 45 per cent. more a typical savannah country, the western traverses unproductive and sparsely populated country for 45 per cent. of its length. The more promising areas for white settlement (which moreover are small and widely scattered) are not actually touched by either alternative. Altogether Mr. Gillman considers that on the western route conditions are so unfavourable as to preclude such development as might permit interest on capital expenditure within a generation or two. The eastern line is not only technically the better and cheaper, but passes through the economically most promising parts of the south-western area, and is regarded as the only feasible solution of the problem. As a link in a future line of Imperial through communication, the eastern route is also held to offer the greater advantages, though it is allowed that certain possible areas of white settlement would be better served by the western.

The report brings out clearly the inexorable nature of the geographical controls which are the final arbiters in such a question. It is illustrated by two sheets (joined) of the official 1/2M map, on which the suggested railway routes have been over-printed in red.

OBITUARY

DR. CHARLES HOSE, D.SC.

By the death of Dr. Charles Hose on 14 November last, a remarkable personality was lost to the world, and to the Royal Geographical Society a member of thirty-eight years' standing.

Born in 1863, Hose was educated at Felsted and at Jesus College, Cambridge, and in 1884 went out to Sarawak, then under Sir Charles, second Raja of the Brooke dynasty. In twenty years he rose to the highest rank in the State Civil Service, becoming a member of the Supreme Council and a Judge of the Supreme Court of Sarawak in 1904. He retired in 1907, and was later appointed a member of the Sarawak State advisory Committee in London.

His first appointment in Sarawak was to the Baram District, then quite recently acquired by the Sarawak State, entirely unexplored and inhabited by Dyak and other wild and warlike tribes. Here Hose developed a remarkable administrative capacity and acquired much influence amongst the inhabitants, to which his great stature, energy, and powers of endurance contributed perhaps scarcely less than the sympathetic intelligence combined with courage, firmness, and equity that inspired his administration.

Endowed with keen perception, perseverance, and an intense interest in all nature, Hose soon became deeply immersed in study of the natural phenomena presented by the unknown tropic country it was his good fortune as well as his duty to explore. He was elected a Fellow of this Society in 1892, and in 1893 read a paper on "A Journey up the Baram River to Mt. Dulit," receiving the Cuthbert Peek Grant in that year. His researches in Natural History brought him into relationship with scientists abroad as well as in England, while his ethnological, zoological, and geological discoveries and contributions to science were recog-

nized by decorations and distinctions from more than one Foreign Government and Learned Association. He always maintained communications with his University, and when, in 1898, the Cambridge Ethnological Expedition visited Borneo, his friend Dr. Alfred Haddon found in him a coadjutor whose knowledge and assistance contributed largely to the success of the undertaking. In 1900 Hose again read a paper before this Society, and in the same year Cambridge conferred upon him the honorary degree of Doctor of Science, in recognition of his distinguished work and of his contributions to the science collections of the University.

On retirement in 1907, far from relaxing his energies, Hose entered upon a new and equally active phase of his life. His geological studies in Borneo enabled him to render services of much value to Sarawak and to the Empire, for subsequent investigation in this direction which he now undertook, resulted in the establishment at Miri, not far from the Baram River, of an oilfield with a yearly capacity of 700,000 tons. His untiring devotion to research, which covered all manner of subjects, was given a new direction by the War, during which he was Superintendent of the munitions factory at King's Lynn and later Chairman of the Cotton Waste Mills Investigation Committee, and it was not until 1919 that he was free to return to his former pursuits. His last decade was to the full as active as any other period of his life. Books, papers, magazine articles, followed each other in rapid succession from his pen; he served on the Council of many Societies, including a term on the Council of this Society (1925); in 1924 he directed the exhibit of Sarawak at Wembley; in 1926 he was elected to a Fellowship of his old college, an honour which gratified him intensely; and in July of last year he received the freedom of the City of London. His health suffered in 1928, but he soon recovered and was contemplating a full programme of work to come when an internal complication unexpectedly put an end to his life. He will long be remembered with affection by the friends his genial nature made for him wherever he went.

In 1912 Dr. Hose published, in collaboration with Dr. W. McDougal, a two-volume book, 'The Pagan Tribes of Borneo,' a work of classic importance which added much to his already high reputation as an ethnologist. In 1923 there appeared the map of Sarawak on a scale of 1 : 500,000, which he had compiled. His next important book was 'Fifty Years of Romance and Research,' produced in 1925, and this was followed in 1928 by 'Natural Man: A Record from Borneo,' which met with much success. In October of last year he published 'The Field-book of a Jungle Wallah,' and in the same year he made preparations for what was to be his *magnum opus*, A History of Sarawak, which, however, he was not destined to write.

His widow, to whom the Society extends sincere condolences in her bereavement, was closely associated with her husband in all his research and literary work.

W. A. G.

CORRESPONDENCE

THE AFRICAN BULGE

In the *Geographical Journal* for December 1929, a copy of which has just reached me, Professor Arthur Holmes, in a very interesting review of the second edition of Dr. Harold Jeffrey's well-known book 'The Earth,' says (p. 587) with reference to a supposed excess of material about the longitude of Central Africa

and Hawaii, "If Africa has this bulge—and it appears to be quite genuine—then clearly, in accordance with the delicacy of isostatic readjustment elsewhere (for example, in Scandinavia), it ought to be a dominantly subsiding area. On the contrary, there have been surprising changes of level in Africa since the Cretaceous, and the Tertiary uplift is apparently still going on. What is the process responsible for this uplift, and how has it pushed Africa up beyond the level of isostatic equilibrium? Does it not seem that some deep-seated process is operating which is actively preventing equilibrium?"

Exactly so. The geology of vast areas of Africa falls, for students of geomorphology and prehistory (and the two subjects are inseparably bound in this country), into two periods, if one may use the term in its wide non-geological sense, namely, pre-peneplain and post-peneplain. The distinction is fundamental. There have been several periods of peneplanation, but it is to the latest of these that the above remark refers. And the peneplain itself is of such amazing perfection that a vast period of tectonic stability must have been necessary for its formation. One can hardly doubt that before this stable state was upset, as it was in Tertiary times, isostatic equilibrium must not only have been reached but must have been long maintained. Now the base-level of peneplanation was clearly the ocean, and it is difficult to imagine so perfect a plain rising thousands of feet above the sea, as it does to-day, unless it had been bulged up since its formation; and that this has indeed happened is evidenced by the topography of the country and the dissection the plateau has undergone, and is still undergoing. Not only is there abundant evidence of the bulging, but there is more than enough to show that very remarkable changes of level have taken place within the human period, and seismological proof that tectonic activity is not yet dead.

This bulging suggests very deep-seated compression. But Africa is not just one great bulge; there are minor bulges on the major one; that is to say, the major bulge is not geometrically perfect, nor are the stresses within equally distributed (or all necessarily of the same sign, for that matter); and it would seem that certain of the rift valleys are associated with the disappearance of one of these bulges. The orientation of the rift valley system with reference to the Indian Ocean on the one hand and Lake Victoria on the other hints at some sort of genetic relationship, and conveys the suggestion that these waters overlie dynamic centres. Certainly the manner in which the groups of these rifts embrace the great equatorial lake is striking, and this embracement has been brought about in spite of the grain of the country. It cannot be accidental, and one aspect of the relationship of Lake Victoria to the almost encircling Graben is admirably brought out by the 1/M Map of Uganda Protectorate, 1929, compiled and drawn in the Survey Department, Entebbe. On that admirable sheet altitudes are indicated by layer colouring, and this, together with more details of river systems than has hitherto been displayed on a one-piece map of the Protectorate, stresses some important facts that in general had been previously deduced by geological methods. They relate to river reversals and the one-time bulge already referred to. The following are three of the many points brought out:

1. Lake Kioga is a drowned river system unconnected with Lake Victoria (though some of its feeders rise within a very few miles of the latter) except by one extremely juvenile stream—the Victoria Nile.

2. The rivers that now feed into Lake Victoria once ran the other way and were at one time (that must have been in pre-rift days) tributaries of the Congo system.

3. The one-time upper waters of some of these rivers (for example, the Katonga) lie beneath Lake Victoria, and are partly represented to-day by drowned valleys.

It should be noted that similar drowned valleys occur all round Lake Victoria.

What then are the inferences one is permitted to draw from the facts as we know them at present? Clearly they are these:

(*a*) Lake Victoria and the rift valleys that nearly surround it (at any rate those that have been studied in Uganda) are younger than the main river systems.

(*b*) Lake Victoria was once a watershed apparently of domoid form (a minor bulge) distributing its streams radially.

(*c*) Since then some change, presumably tectonic, has brought about the reversal of the rivers so that they now drain towards instead of away from the one-time bulge.

Field work upon the distribution and history of certain auriferous gravels, the results of which will be published this year, clearly indicate that the nature of the reversal (or reversals, for the event has happened more than once) was tectonic, and it would seem that the appearance of the encircling rift valleys, and the subsidence (relative, I believe) of the bulge that once existed over the site of Lake Victoria were contemporaneous phenomena.

The evidence, as I read it, goes to show that as the Victoria bulge subsided so the rift valleys embracing it appeared; and as the subsidence of the bulge continued so the sides of the rift valleys rose and their floors were depressed.

As to the nature of this movement I do not wish to say more in this place. The matter will be treated at further length in the Annual Report of the Geological Survey of Uganda for 1929, and in much greater detail, and perhaps from an entirely different viewpoint, by Professor Bailey Willis in a forthcoming book. Meanwhile there are three points to which I should like to direct attention. They are these:

1. My remarks in the *Geographical Journal* for August 1929, pp. 132–154, with regard to linear upwarps, are now out of date, so far as I am concerned. I definitely abandoned the idea some seven months ago; and the evidence as we have it to-day goes to show, or so it seems to me, that linear upwarps (such as I postulated) have never existed at any time in the history of the rift valleys; that in fact the rift valleys do not run along the crests of arches, and the depressed keystone effect has been entirely produced by differential movement—that is to say, by the rise of the valley sides and the depression of the floor.

2. Students and teachers interested in physical geography could hardly do better than study the 1/M map of Uganda to which I have called attention.

3. (Most pertinent to the point of this letter.) The rift valleys are secondary phenomena. They are indeed incidental to the main phenomenon, which is the anti-isostatic bulging of Africa.

E. J. WAYLAND.

Homa Bay, Lake Victoria,
25 January 1930.

ZERZURA

With regard to the Zerzura problem (*Geographical Journal* for January, pp. 48–64), the subjoined account of Zerzura, given recently by certain of the Wulad Suleiman Arabs of Kanem, may be of interest.

The Arabs say that Zerzura, the Baḥr al 'Ajuz and Al Marbut are all the same, and denote the same place. Some people call the place Zerzur because it was a place of highway robbery. In Arabic a man was said to "wazar" (*i.e.* perpetrate a robbery) when he engaged in a raid, and plundered travellers who had come from a distance.

When a hostile band heard of the approach of other travellers to this place, they tied up (Marbut) the road, and watched them approach in order to take their goods and make them prisoners. Hence some people called the place Marbut.

But most people from olden days onwards called the place Bahr al 'Ajuz, since there was seen there an old woman with two black goats; she had been there since long ago: she was not recognized as belonging either to the "jinn" or to mankind. Hence many people call the place Bahr al 'Ajuz.

Between this place and Abeshe, capital of Wadai, is fifteen days' march. Between it and Egypt is forty days' march by rapid travelling. Between it and Al Fasher, capital of Darfur, is fourteen days' march, while from it to Kufra is twenty days' march. All people know the place.

This Zerzura is said to be south of Owenat and east of Wanyanga or Wajunga in Borku, *i.e.* about latitude 20°. As recently as 1923 it was reported in Bornu that the last of the "goats" of the old lady of Bahr al 'Ajuz had died, and therefore that the arrival of the "Mahdi" might be expected at any moment.

H. R. PALMER.

Kaduna, Nigeria,
20 February 1930.

MEETINGS: SESSION 1929–1930

Eighth Evening Meeting, 24 February 1930. The President in the Chair

Elections: William Thomas Bailey; Stanley H. Beaver, B.A.; Major Otho Lennox Browne, B.A.; Sir Geoffrey L. Corbett, K.B.E., C.I.E., I.C.S.; John Ernest de Lengerke; Gordon M. Dyce-Keele; Claude St. Aubyn Farrer, F.R.C.P., F.R.C.S., PH.D., F.S.A.; Robert H. Kulka; John Burnett Laws; Ormond Stanley Lucas; Major E. A. Marples, F.R.A.I.; John Robert Milligan; Harold Thomas Mirrington; Ernest Herbert Neville, F.R.E.S.; Lt.-Commr. Rory Chambers O'Conor, R.N.; V. C. Scott O'Connor; Miss Maud Phillips; Miss Dorothy Margaret Redgrave; Leslie James Stevenson; Edward Cairns Thomas; Edward Sheldon Wilkinson; Mrs. Charlotte Mildred Woods

Paper: The Italian Expedition to the Karakoram. By H.R.H. the Duke of Spoleto

Additional Afternoon Meeting, 25 February 1930. Sir Francis Younghusband in the Chair

Paper: Geological Work of the Italian Expedition to the Karakoram. By Prof. Ordito Desio

Ninth Evening Meeting, 10 March 1930. The President in the Chair

Elections: W. E. Barber; Francis Arthur Buchanan Barnard, M.A.; William Anthony Fairfax Barnes; Miss Kathleen Mary Booker, M.SC.; Alexander Cannon, M.D.; Nares Chandra Chatterjee, M.A.; Norman Hart; M. N. A. Hashmie, B.A.; David McLean; Miss Gwendoline Dora Percival; Signor Vittorio Ponti; Harold Herrick Lord Sands, M.I.M.E., F.S.A., F.R.H.S.; J. M. Scott; Miss Dora Kate Smee, M.A., PH.D.; Capt. G. W. Tailby; Mrs. A. Wyndham Tarn; Ernest Walter Gabot Wesson

Paper: The Seinghku and Delei Valleys, North-East Frontier of India. By Mr. F. Kingdon Ward

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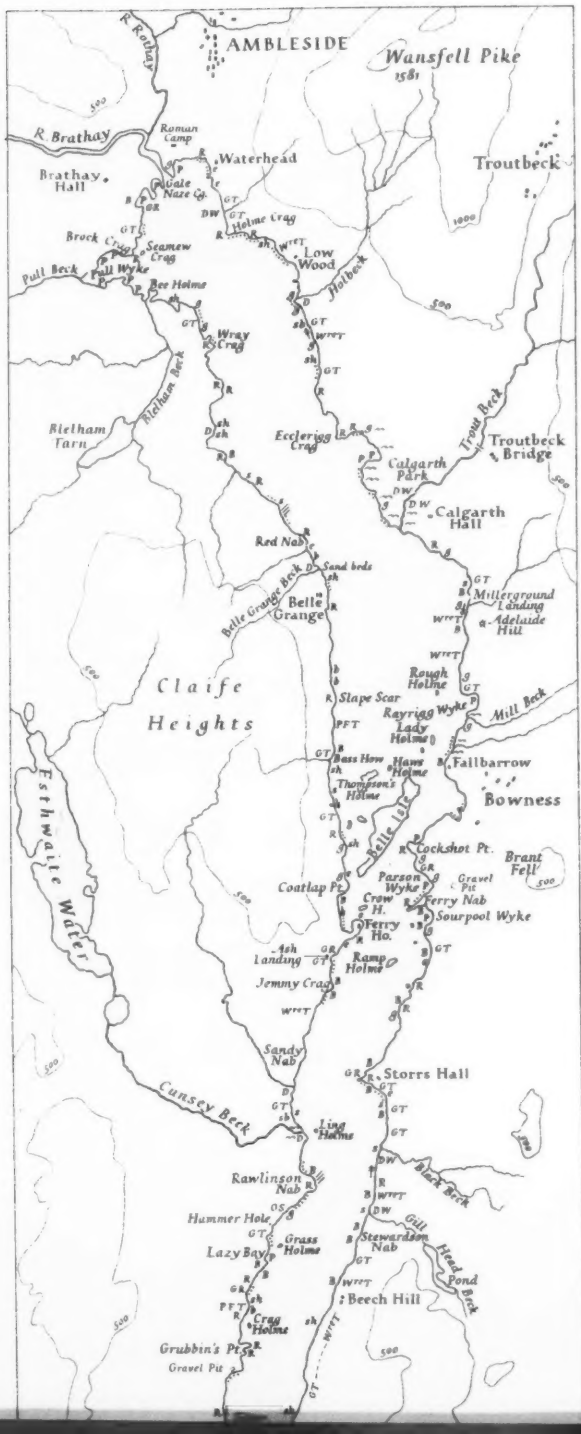

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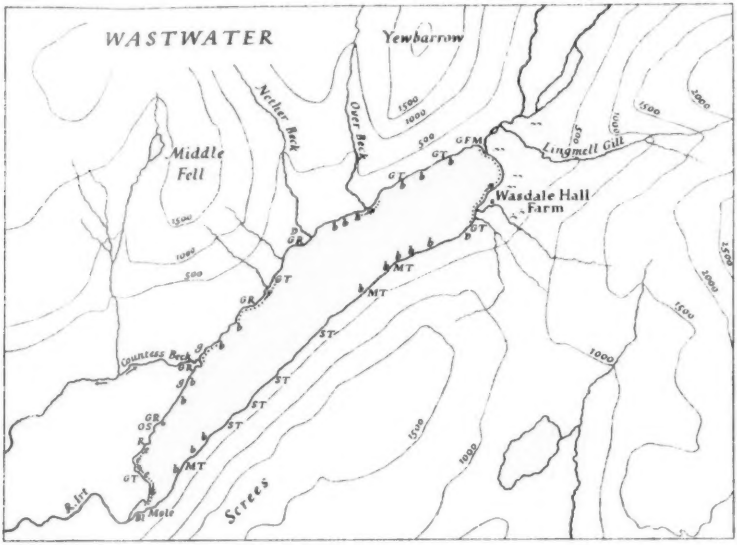
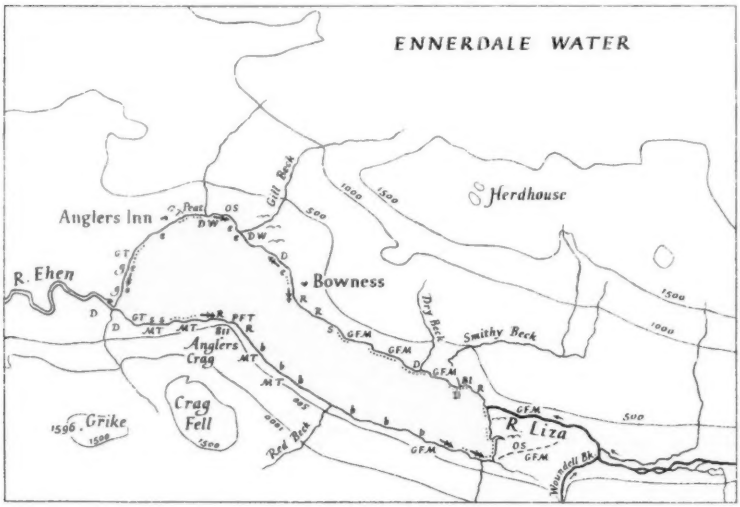
RAPHY OF THE ENGLISH LAKES

By Thomas Hay





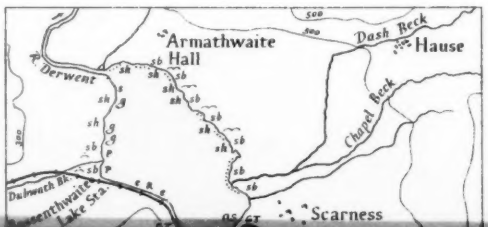
Reference

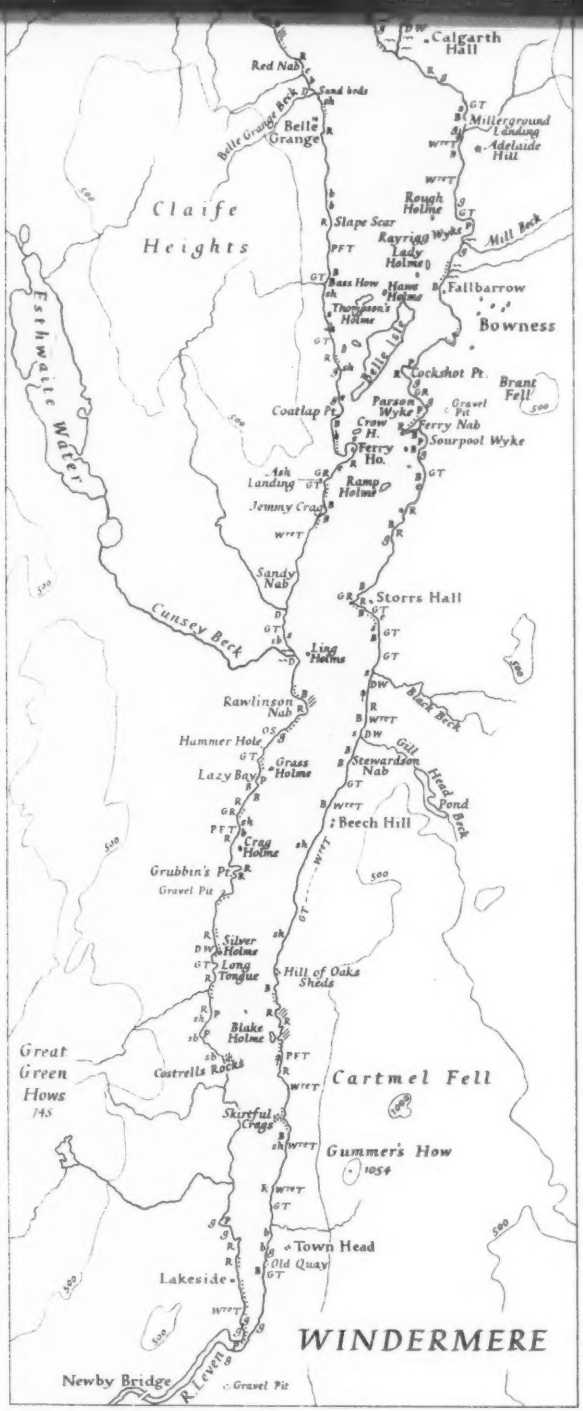
Types of Coastline:

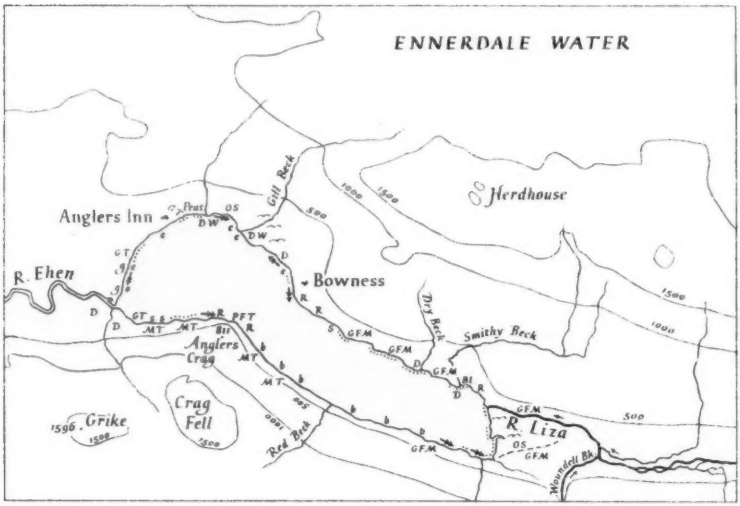
Glencoin Type	GT
Watermillock Type	WT
Windermere Type	WMT
Place Fell Type	PFT
Mellbreak Type	MT
Scree Type	ST

Nature of Actual Beach:

Shingle or small gravel	
Grass or small plants	




Calgarth Hall
Red Nab
Sand beds
Belle Grange Beck
Belle Grange
Millerground Landing
Adelaide Hill
Claife Heights
Rough Holme
Slape Scar
Rayrigg Wyke
Mill Beck
Lady Holme
Bass How
Hawe Holme
Fallbarrow
Thompson's Holme
Bowness
Belle Isle
Cockshot Pt.
Brant Fell
Parson Wyke
Gravel Pit
Coatlap Pt.
Crow H.
Ferry Nab
Sourpool Wyke
Ferry Ho.
Eastwaite Water
Ish Landing
Ramp Holme
Jemmy Crag
Sandy Nab
Storrs Hall
Cunsey Beck
Ling Holme
Rawlingson Nab
Black Beck
Hummer Hole
Grass Holme
Stewardson Nab
Gill
Head Pond
Lazy Bay
Beech Hill
Crag Holme
Grubbin's Pt.
Gravel Pit
Silver Holme
Long Tongue
Hill of Oaks
Sheds
Blake Holme
Great Green Hows
Castrells Rocks
Cartmel Fell
Skirtful Crags
Gummer's How
1054
Town Head
Old Quay
Lakeside
WINDERMERE
Newby Bridge
R. Leven
Gravel Pit



Reference

Types of Coastline:

- Glencoin Type ... GT
- Watermillock Type ... WT
- Windermere Type ... WmT
- Place Fell Type ... PFT
- Mellbreak Type ... MT
- Scree Type ... ST

Nature of Actual Beach:

- Shingle or small gravel ...
- Grass or small plants ... g
- Shrubs ... sh
- Stones (up to about 5 ins. across) ... s
- Boulders ... b
- Glacial Boulders ... B
- Live Rock ... R

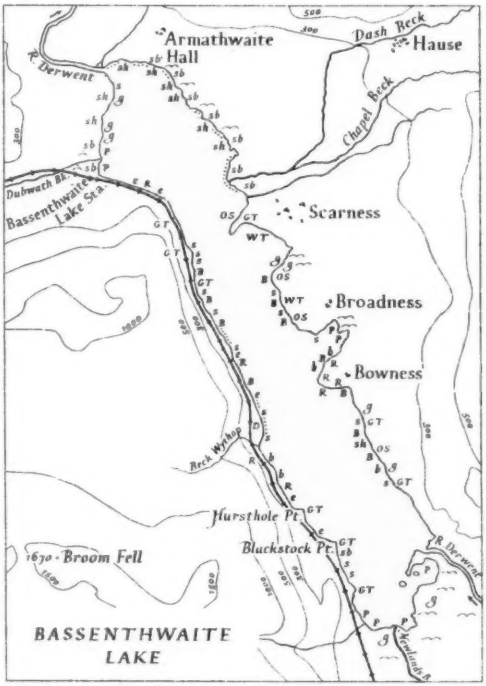
Other Symbols:

- Embankment ... e
- Alluvium ...
- Moraine mounds or Eskers ...
- Plants in water (rushes, reeds, etc.) P
- Storm Beach ... sb
- Older lake shore ... OS
- Movement of gravel along shore ...
- Delta ... D
- Delta with windward trend ... DW
- Glacio-Fluvial material ... GFM
- Glaciated Rock ... GR
- Bloomery ... Bl
- Direction of outcrop / dominating structure ...

Scale 1:63,360

½ 0 Miles ½ 1

Heights in feet



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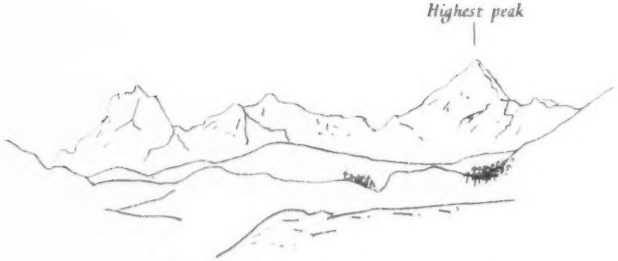
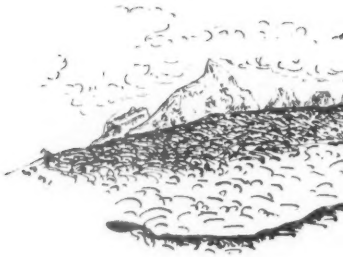
ENGLISH LAKES
Hay

UNIV. OF MICH.



1 *Minya Gonka from a point (12,900 ft.) two miles north of Tailing Gompa, looking S.S.E. Peak N. 165° E. 26 Jul. 1929.*



4 *Jara from camp (13,500 ft.) a little no Hlagong Gompa, looking east. 19 Ju*

2 *Minya Gonka from Yingkwanchai (12,450 ft.). 15 Jul. 1929.*

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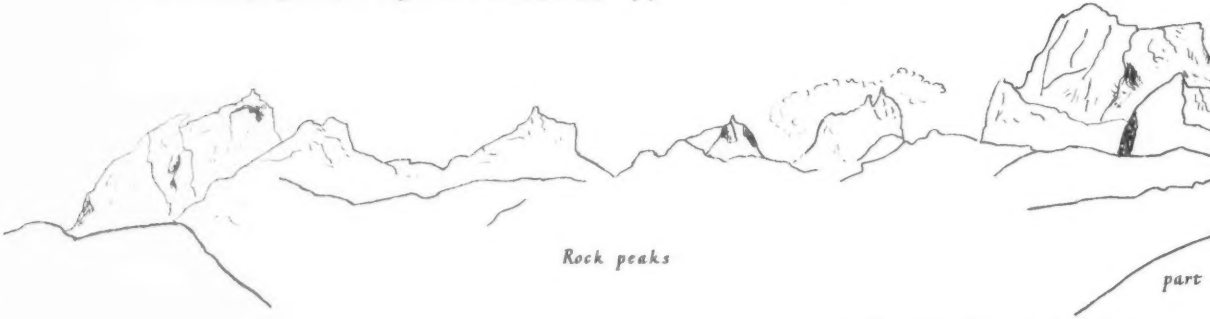
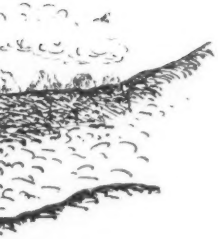


3 *Range S.W. of Tatsienlu from Haja La (15,300 Minya Gonka on extreme right. 31 May 192*

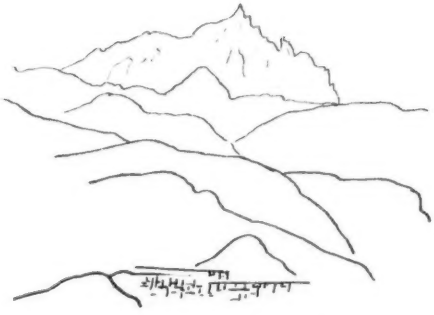
part

TCHES OF THE TATSIENLU PEAKS

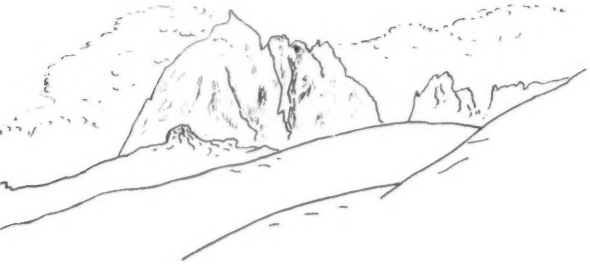
By Herbert Stevens



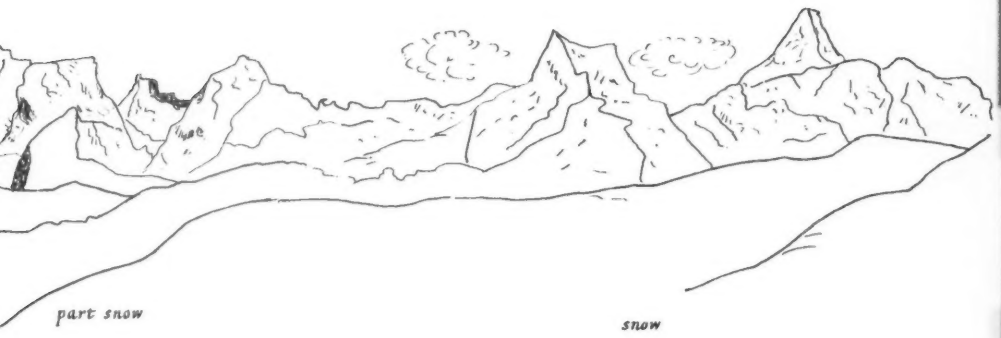
ft.) a little north of
east. 19 Jul. 1929.



5 *Jara from camp (12,300 ft.) south of Pamei Gompa. 23 Jul. 1929.*



6 *Jara from a point (13,600 ft.) south of Hlagong Gompa, looking east. 21 Jul. 1929.*



aja La (15,300 ft.)
31 May 1929.

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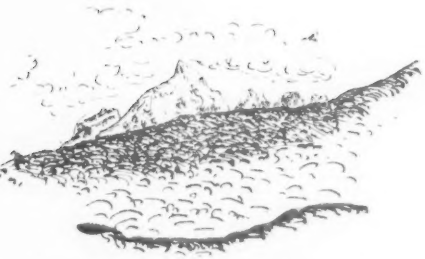
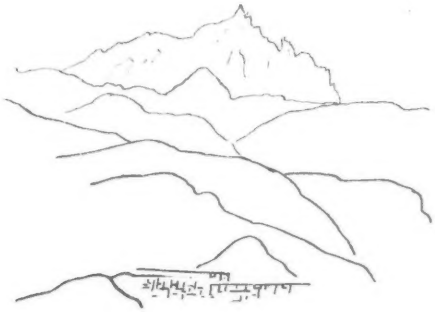
SKETCHES OF THE TATSIENLU PEAKS

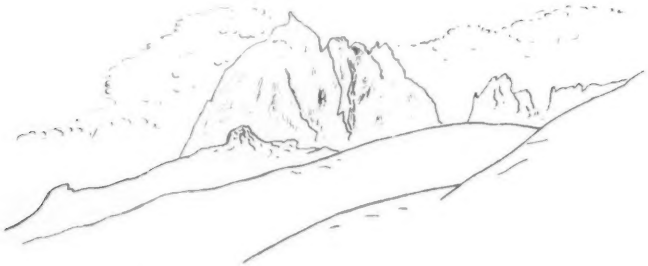
By Herbert Stevens



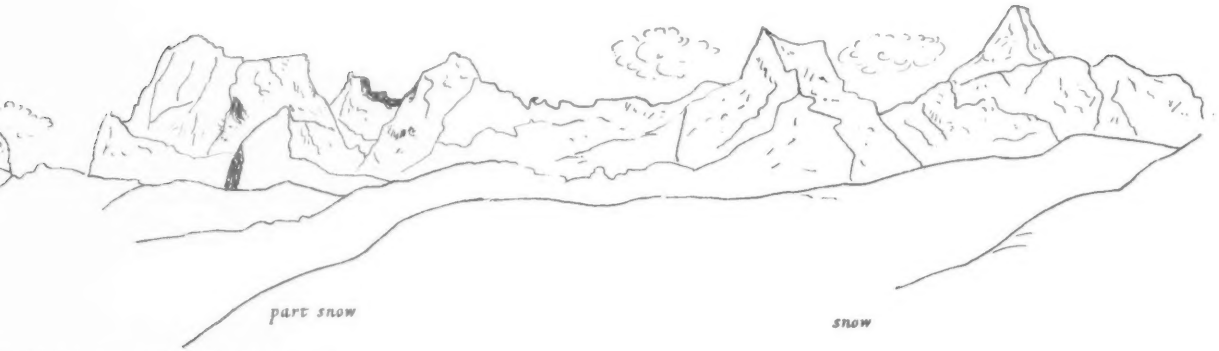
4 *Jara from camp (13,500 ft.) a little north of Hlagong Gompa, looking east. 19 Jul. 1929.*



5 *Jara from camp (12,300 ft.) south of Pamei Gompa. 23 Jul. 1929.*



6 *Jara from a point (13,600 ft.) south of Hlagong Gompa, looking east. 21 Jul. 1929.*



ge S.W. of Tatsienlu from Haja La (15,300 ft.) nya Gonka on extreme right. 31 May 1929.

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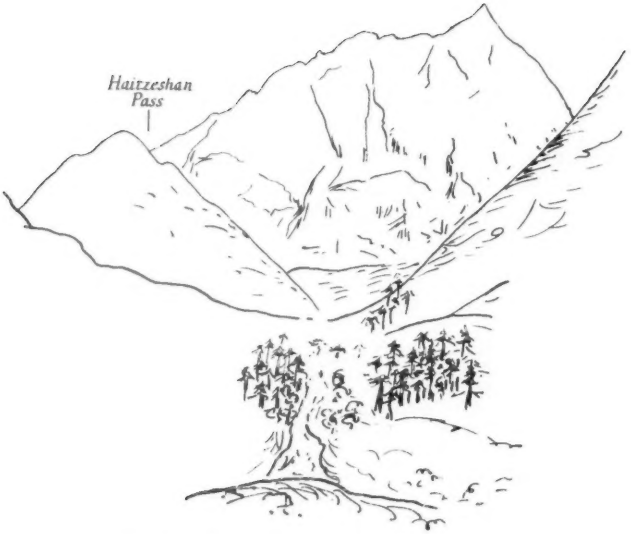

7 Jara from camp (13,000 ft.) about 10 miles east of Tailing, looking S.E. 3 Aug. 1929.

8 Mountains S.E. of Tatsienlu from north of Meipong, looking S.S.W. 20 Aug. 1929.

TATSIENLU
Stevens